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PHYLLOTAXIS OF CONES.

BY PROFESSOR W. J. BEAL.

In the summer of 1870 I examined a large number of cones of several species of Coniferæ to see if there was any variation in their leaf arrangement. It has long been well known that the scales or leaves of cones show very plainly a certain number of parallel spiral whorls twisting to the right and a different number twisting to the left. A closer examination will also usually reveal other parallel whorls (one or more in each direction) with numbers differing from those most easily seen. By beginning with the simplest forms of alternate leaf-arrangement, as the elm ($\frac{1}{2}$), and sedges ($\frac{1}{3}$); and then to the more common but more complicated, as the cherry ($\frac{2}{5}$), and American larch ($\frac{3}{8}$), it is found that in these fractions the numerator expresses the number of times we pass around the stem to find a leaf directly over the one with which we started, while the denominator indicates the number of vertical ranks or rows of leaves up and down the stem. This is nicely proven to be true in the case of a fraction with large numerator and denominator in the leaves of *Yucca filamentosa*, where the fraction is thirteen thirty-fourths, if memory is not at fault. In Yucca the bases of the leaves are so broad that they reach about half-way around the stem, so it is easy to see which is below or outside of all the others. The fractions above mentioned also express the angular divergence or show the proportion of the

whole circumference which intervenes between any two consecutive leaves of the same spiral whorl. Stretch a wire or band with marks or appendages so as to be alternate, two-ranked as are the leaves in the elm; then by giving the band a twist, it brings the marks three-ranked, like the sedges; still farther torsion brings them five-ranked, like the leaves of a cherry tree; still more twist and they stand as the scales of the American larch, which is expressed by the fraction three-eighths.

The most common series of fractions found in alternate leaves is $\frac{1}{2}$, $\frac{1}{3}$, $\frac{2}{5}$, $\frac{3}{8}$, $\frac{5}{13}$, $\frac{8}{21}$, $\frac{13}{34}$, $\frac{21}{55}$, $\frac{34}{89}$, etc. The relations of these several numerators and denominators have been repeatedly shown by various authors.

After the first two fractions, each succeeding one may be made by adding both of the previous numerators for its numerator and both of the previous denominators for its denominator. Each denominator is the same as the second succeeding numerator. "Also, taking the orders of secondary spirals nearest the vertical line, on each side, right and left, the number of parallel spirals of the lower order of these two will give the numerator; and this number, added to the number of parallel spirals of the higher order will give the denominator."—*Henfrey*. Also "the number of the parallel secondary spirals is the same as the common difference of the numbers on the leaves that compose them."—*Gray*. These relations enable us to number easily each scale of any cone, or count the spirals each way, and then determine with accuracy the fraction expressing its Phyllotaxis. Balfour and Gray in their text books say the Phyllotaxis is uniform in the same species, and that one direction or the other generally prevails in each species, and that both directions are sometimes met with in different cones of the same tree. Several other text books make the same assertions. Most authors on this subject with which I am familiar say there are only rare cases of other series of spirals. P. Duchartre mentions two other series, viz: $\frac{1}{3}$, $\frac{1}{4}$, $\frac{2}{7}$, $\frac{3}{11}$, $\frac{5}{18}$, $\frac{8}{29}$, etc., $\frac{1}{4}$, $\frac{1}{5}$, $\frac{2}{9}$, $\frac{3}{14}$, $\frac{5}{23}$, etc., and observes that the same relation exists in different fractions of each series as exist in the fractions of the more common series.

Mr. Hubert Airy recently read a paper before the Royal Society, England, an abstract of which is given in "Nature" for March 6, 1873. After mentioning some experiments which show the intimate relations of different fractions of the common series,

he adds: "It also appears that the necessary sequence of these successive steps of condensation, thus determined by the geometry of the case, does necessarily exclude the non-existent orders $\frac{1}{4}$, $\frac{3}{7}$, $\frac{4}{9}$, $\frac{4}{11}$, etc." This conclusion "determined by the geometry of the case," proves to be only an incorrect theory, as shown by the following:

I examined nearly all the cones (one hundred and fifty-five) which grew upon a Norway spruce, seventy-four of which showed five parallel spirals to the right and eight to the left; while seventy-four showed eight spirals to the right and five to the left. Five cones had seven spirals to the right and four spirals to the left. One cone had four spirals to the right and six to the left, and one cone had six spirals to the right and four to the left. I will try to tabulate this and others in a briefer manner: —

NORWAY SPRUCE. . . .	74	Cones	had	5	spirals	to the	right,	8	to the	left.
On Tree No. 1.	74	"	"	8	"	"	"	5	"	"
	5	"	"	7	"	"	"	4	"	"
	1	"	"	4	"	"	"	6	"	"
	1	"	"	6	"	"	"	4	"	"
On Tree No. 2.	18	"	"	5	"	"	"	8	"	"
	21	"	"	8	"	"	"	5	"	"
	1	"	"	4	"	"	"	6	"	"
On Tree No. 3.	5	"	"	5	"	"	"	8	"	"
	19	"	"	8	"	"	"	5	"	"
	1	"	"	7	"	"	"	4	"	"
On Tree No. 4.	23	"	"	8	"	"	"	5	"	"
	17	"	"	5	"	"	"	8	"	"
	4	"	"	7	"	"	"	4	"	"
	2	"	"	4	"	"	"	7	"	"
	1	"	"	4	"	"	"	6	"	"
	1	"	"	6	"	"	"	4	"	"
On Tree No. 5.	34	"	"	5	"	"	"	8	"	"
	44	"	"	8	"	"	"	5	"	"
	6	"	"	4	"	"	"	7	"	"
	3	"	"	7	"	"	"	4	"	"
	1	"	"	4	"	"	"	6	"	"
	2	"	"	6	"	"	"	4	"	"
On Tree No. 6.	63	"	"	5	"	"	"	8	"	"
	53	"	"	8	"	"	"	5	"	"
	1	"	"	4	"	"	"	7	"	"
	6	"	"	7	"	"	"	4	"	"
	4	"	"	4	"	"	"	6	"	"
	8	"	"	6	"	"	"	4	"	"
On Tree No. 7.	9	"	"	8	"	"	"	5	"	"
	13	"	"	5	"	"	"	8	"	"
PINUS PUMILIS.	10	"	"	5	"	"	"	8	"	"
	9	"	"	8	"	"	"	5	"	"
EUROPEAN LARCH. . .	29	"	"	5	"	"	"	13	"	"
	51	"	"	13	"	"	"	5	"	"
	3	"	"	4	"	"	"	7	"	"
	2	"	"	7	"	"	"	4	"	"
	1	"	"	3	"	"	"	6	"	"

BLACK SPRUCE.	80	Cones	had	5	spirals	to the	right,	8	to the	left.
Cones for 1869.	65	"	"	8	"	"	"	5	"	"
	3	"	"	4	"	"	"	7	"	"
	2	"	"	7	"	"	"	4	"	"
	1	"	"	4	"	"	"	6	"	"
	3	"	"	6	"	"	"	4	"	"
Same tree in 1870. . . .	26	"	"	5	"	"	"	8	"	"
	23	"	"	8	"	"	"	5	"	"
	2	"	"	7	"	"	"	4	"	"
AMERICAN LARCH. . .	30	"	"	3	"	"	"	5	"	"
	34	"	"	5	"	"	"	3	"	"
	3	"	"	4	"	"	"	6	"	"
	1	"	"	6	"	"	"	4	"	"
	1	"	"	7	"	"	"	4	"	"
	1	"	"	3	"	"	"	4 & 10	"	"

In all of these cases it was possible to see other spirals, but I have mentioned those most apparent in each case. For instance, in the most common forms of Norway spruce, there were spirals with three rows, eight and twenty-one one way, and five and thirteen the other way. Other cones showed three and seven one way, and four and eleven the other.

To cut this article short, the fractions for most cones of Norway spruce was $\frac{13}{34}$, for others it appears to be $\frac{11}{29}$, and for others $\frac{10}{26}$. By operating with the fraction $\frac{11}{29}$ and other numbers of spirals on the cones in the same way as we may on the most common forms, we get this series of fractions, viz: $\frac{1}{4}$, $\frac{3}{7}$, $\frac{4}{11}$, $\frac{7}{18}$, $\frac{11}{29}$, etc. Other cones noticed in the table as having four and six spirals, had also two, ten, and sixteen. The fraction for these was $\frac{10}{26}$, and would be found in a series $\frac{2}{4}$, $\frac{2}{6}$, $\frac{4}{10}$, $\frac{6}{16}$, $\frac{10}{26}$, $\frac{16}{42}$, etc. The latter we observe, when each fraction is reduced to its lowest terms, is the same as the first or most common fractions mentioned. Most cones of the European larch had the phyllotaxis expressed by the fraction $\frac{8}{21}$, others by $\frac{7}{18}$, one other by $\frac{6}{15}$. This latter cone had three, six and nine spirals, and falls into the following series, viz: $\frac{3}{6}$, $\frac{3}{9}$, $\frac{6}{15}$, $\frac{9}{24}$, $\frac{15}{39}$, etc. Most cones of the American larch fall under the fraction $\frac{3}{8}$, others $\frac{4}{10}$, others $\frac{3}{7}$.

In these few examples the same number of parallel spirals is about equally divided in the two directions, right and left. They also show that other series than the one usually accepted as almost universal, are not uncommon, as they may be found on a variety of coniferous trees, though in smaller numbers.

Plants with the leaves opposite generally have them four-ranked up and down the stem, and then the leaves are said to *decussate*. If we start with a plastic stem of this nature we get a fraction $\frac{2}{4}$ to express it; giving the axis a slight twist we get $\frac{2}{6}$, another

twist we get $\frac{4}{10}$, another twist $\frac{6}{16}$, etc. Some of our cones, then, fall into the phyllotaxis of opposite leaves the same as though the stem were more or less twisted. The single cone of the European larch which indicated the fraction $\frac{6}{15}$ (a fraction requiring a division of numerator and denominator by three to reduce it to its lowest terms) falls under decussate whorls of three for its simplest fraction.

I leave any further consideration of this matter showing the relations of the fractions to each other, etc., to those who have a greater skill in mathematics than myself. My examples indicate that we may look for some curious series of fractions by diligently examining the phyllotaxis of a great number of plants of many different species.

It would be interesting to know whether there are any cones which fall into series beginning with decussate whorls of four or more scales.

ON THE DISTRIBUTION OF CALIFORNIAN MOTHS.*

BY A. S. PACKARD, JR.

THE Phalænidæ (Geometrids) of California (including Oregon and Nevada) seem to be composed of four elements: (1) of species of genera exclusively American (North and South). Such are *Chœrodes*, *Sicya*, *Hesperumia*, *Tetracis*, *Azelina*, *Gorytodes* and *Metanema*. Certain species of these, with several of *Tephrosia* (a genus largely found in the New World) are the most characteristic of the Pacific slope of the United States.

(2) The species next most characteristic belong to the following genera: — *Halia*, *Tephrina*, *Selidosema* and *Heterolocha*. Species of these groups occur in Europe, but especially (all except *Halia* which has a species (*H. novaria*) living in northern Europe) in southern Europe, around the Mediterranean Sea, western Asia, and Asia Minor; while species of Heterolocha occur in Abyssinia and South America (Quito).

(3) The next group comprises a few arctic or circumpolar species of *Coremia*, *Cidaria* and *Larentia*, or of cosmopolite genera

*Extracted from a communication presented to the Boston Society of Natural History, May 7, 1873.

such as *Hypsipetes*, *Cidara*, *Coremia*, *Eupithecia*, *Scotosia*, *Acidalia* and *Boarmia*.

(4) There are four species common to both the Pacific and Atlantic states, viz., *Larentia cumatilis*, *Camptogramma gemmata*, *Tephrosia Canadaria* and *Azelina Hübneraria*.

In the brief introductory remarks to the first part of this Catalogue (these Proceedings vol. xiii, 381) we briefly alluded to the fact that some Californian Lepidoptera repeat certain features peculiar to the fauna of Europe. I find that there are but two forms strikingly European among the Phalænidæ, viz., *Numeria Californiaria* Pack. (wrongly described by me as *Ellopia Californiaria* xiii, p. 384) which is very near the European *Numeria pulveraria*, and quite different from the Atlantic states *N. obfirmaria*, and the genus *Chesias* which does not, so far as yet known, occur in the Atlantic region.*

But if we find a very few species which recall the European fauna, there are on the other hand many peculiar European genera which do not occur in the Pacific region. In other groups of Lepidoptera there are some species that recall European types; such, especially, are *Papilio Zolicaon* Boisd., representing the European *P. Machaon*, and the genus *Parnassius*, which does not occur in the Atlantic region.

Going out of the Phalænidæ, we find a few European types of Bombycidæ which occur in California and are not found in the Atlantic states, such as the genera *Epicallia* and *Callarctia*.

On the other hand we find in California no such development of the genus *Lithosia* as in Europe, no species of *Zygæna*, no *Psychidæ* (except *Phryganidia*, an aberrant form); no such development of *Hepialus*, while *Xyleutes robiniæ*, as in the Atlantic states, represents the European *Cossus ligniperda;* moreover the various forms of *Lasiocampa* and other allied genera are far less numerous if not (*L. Carpinifolia* Boisd. is, according to Grote, a species of Gastropacha) quite wanting in the Pacific region.

We miss again in the Pacific states any species of *Telea* or *Tropæa*, forms linking the Atlantic or northeastern American entomological fauna with that of northeastern Asia (*Telea* being represented by the closely allied *Anthærea* and *Tropæa Luna*

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* I also referred to a supposed species of *Rumia*. On further examination I find that this and the Maine species are types of a genus, different though allied to *Rumia*, and accordingly in the present paper call it *Hesperumia*.

being represented by *T. Selene* Leach). California has evidently not borrowed her insect fauna from northern China or Japan.*

In the Neuroptera we have strong European features, the genus *Rhaphidia*† occurring in the Pacific states, and not in the Atlantic, while *Boreas Californicus* is more like the European *B. hyemalis* than our two Atlantic species.

The crustacean fauna of northeastern America, with Limulus as its most remarkable feature, repeats that of eastern Asia; but on the other hand Dr. Hagen states that the European genus Astacus occurs in California, while Cambarus is only found east of the Rocky mountains.

Mr. F. W. Putnam informs me that of one hundred and seventy-three genera of fishes given by Günther as inhabiting the seas about Japan, only about thirty-six are represented on the northwestern coast of America, and of these thirty-six the majority are also found in the Atlantic, while about eighty others of the Japanese genera are also represented on the southeastern coast of North America and in the West Indian seas, of which a number are found on the western coast of Central America as well. He also tells me that the fresh water fishes of northern Asia, when compared with those of other regions, more nearly resemble those of the northeastern parts of North America, though a number of the genera are also common to both North America and Europe. By the same authority I am informed that there is a striking resemblance between the reptiles and batrachians of northeastern Asia and northeastern America.

My attention has been drawn to a consideration of these features in the geographical distribution of animals by a perusal of the able and suggestive essay by Prof. Gray on the distribution of California plants, in his address at the Dubuque meeting (Aug., 1872) of the American Association for the Advancement of Sci-

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*Dr. Boisduval, who was the first to publish a lepidopterous fauna of California enumerates the following species of Lepidoptera as being common to California and Europe: — *Vanessa Atalanta*, *V. cardui*, *V. Antiopa*, *Chelonia caja* and *C. Dahurica*, *Arctia* [Phragmatobia] *fuliginosa*, *Gonoptera libatrix*, *Phlogophora metriculosa*, *Amphipyra pyramidea*, *Agrotis exclamationis*, *A. annexa*, *A. saucia*, *A. fumosa*, *A. ravida*, *Cucullia asteris*, *C. lucipara*, *Plastenis subtusa* Fabr., *Noctua triangulum*, *N. plecta*, *Hadena pisi*, *H. protea*, *Monogona Hormos*, *Plusia festucæ*, *P. questionis*, *P. ni*.

These are scarcely more distinctive of Europe than of America, some of them being common to the subarctic regions of the two continents, and others may yet prove to be distinct from the European species.

†Rhaphidia has as yet only been found in Europe, northern Asia, and western North America (MacLachlan).

ence, and of Mr. Lesquereux' able papers in Hayden's Geological Reports on the Territories, 1872. The main features in the geographical distribution of land animals are apparently the same with those of plants. Prof. Gray shows that "almost every characteristic form in the vegetation of the Atlantic States is wanting in California, and the characteristic plants and trees of California are wanting here" (*i. e.*, in the Atlantic States). We may on the whole say of the Californian Lepidoptera, at least, as Dr. Gray remarks of the plants, that they are "as different from [those] of the eastern Asiatic region (Japan, China and Mandchuria) as they are from those of Atlantic North America. Their near relatives, when they have any in other lands, are mostly southward, on the Mexican plateau. . . . The same may be said of the [insects] of the intervening great plains, except that northward and in the subsaline [insects*] there are some close alliances with the [insects] of the steppes of Siberia. And along the crests of high mountain ranges the arctic-alpine [insect-fauna] has sent southward more or less numerous representatives through the whole length of the country" (p. 10). He then refers to the "astonishing similarity" of the flora of the Atlantic United States with that of northeastern Asia. Our actual knowledge of the insect species of northeastern Asia is most vague compared with the exact knowledge of the botanist, and the comparison we have drawn relates only to generic types.

It is evident that the notion of continental bridges in quaternary times, connecting for example Asia and California, is quite unnecessary, since there are, so far as is yet known, no forms characteristic of Asia in the Californian fauna, and the grand difficulty is to account for the presence of a certain resemblance to

*Dr. Leconte has noticed the similarity of our saline-plains beetles, containing so many species of Tenebrionidæ, to the fauna of the deserts and steppes of Asia. (Proc. Amer. Assoc. Adv. Sci., 1851. Albany meeting, 252.) He also states that "the only manner in which the insect fauna of California approaches that of Europe, is in the great abundance of apterous Tenebrionidæ. But in this respect it does not differ from a large part of South America; and by the very form of these Tenebrionidæ, which bear no resemblance at all to those of Europe, the greater relation of the Californian fauna to that of the rest of America is clearly proved." Andrew Murray (on the Geographical Relations of the chief Coleopterous Faunæ, p. 36, 1871) also refers to this fact; the genus *Elodes* in California replacing the genus *Blaps*. He adds: "other Heteromerous forms, reminding us of Mediterranean and Asiatic species, occur in California, and the whole of the northwest of America has a greater preponderance of the microtypal stirps than perhaps occurs east of the Rocky Mountains." I should add that Mr. Murray in explaining the term *microtypal*, states that "the fauna and flora of our own land [Great Britain] may be taken as its type and standard."

the European fauna in that of California. Here I think Dr. Gray has been the first to indicate a solution of the problem. Our knowledge of American fossil tertiary insects is at present almost *nil;* we must, then, in the absence of any evidence to the contrary, follow the conclusions of Gray with the later confirmation of Heer and Lesquereux.

The ancestors of the Californian *Parnassius*, *Rhaphidia* and other European forms, may have inhabited the Arctic tertiary continent, of which Greenland and Spitzbergen are the remains, and their descendants forced southward have probably lost their foothold in the Atlantic region and survived in California and Europe, like the Sequoia in California. Something more than similarity of climate is needed to account for the similarity of generic forms; hence community of origin, with high antiquity and a southward migration of forms not of tropical origin, are the factors needed to work out the problem. That something of this sort has taken place in marine animals we know to be the fact. Certain forms now supposed to be extinct on the coast of New England and Scandinavia, such as *Yoldia arctica* Gray (*Nucula Portlandica* Hitchcock), are still living in the seas of Greenland and Spitzbergen. The quaternary fauna of Maine indicates a much more purely arctic assemblage than is at present to be found. This is also the case with the Scandinavian quaternary fauna, according to the researches of Prof. M. Sars. As we have before shown, the circumpolar marine fauna runs down along the coast of northeastern America and of Europe, and the forms common to the two shores have not come one from the other. Europe has not perhaps borrowed in quaternary times from America, but both have been peopled from a purely circumpolar fauna. If there has been any borrowing it has been on the part of Europe, since the fossil musk ox of France and central Europe is said to be identical with the musk ox of arctic America. So also on the coast of northeastern Asia and Alaska are circumpolar forms, which have evidently followed the flow of the arctic currents down each coast. The forms which are identical or representative on these two coasts are forms derived from the circumpolar fauna; so the forms which are so strikingly similar in northern Japan to those on the coast of New England are, if we mistake not, also derived from the northward. I believe it to be a matter of fact that the Atlantic States species of insects which are common to the two countries,

are, if not of circumpolar, at least of subarctic or boreal origin. From these facts we are led to accept the conclusions of Lesquereux and Gray that co-specific or congeneric forms occurring in California and Europe and Asia, are the remnants of a southward migration from polar tertiary lands during tertiary and even perhaps cretaceous times; and in proportion to the high antiquity of the migrations there have been changes and extinctions causing the present anomalies in the distribution of organized beings which are now so difficult to account for on any other hypothesis.

For this reason it is not improbable that those species of insects which are more or less cosmopolite (and independently so of human agency) are the most ancient, just as some forms taxonomically the most remote are remnants of earlier geological periods. For example, the curious anomalies in the geographical distribution of *Limulus*, the genus only occurring on the eastern coasts of Asia and North America, accord with its isolation from other crustacea. Geological extinction has gone hand in hand with geographical isolation. It was a common form in Europe in the jurassic period, and in the next lower (permian) period but one (the triassic intervening) we find other Merostomata and a few Trilobites.

We make these speculations hoping that much light will be thrown upon the subject by studies on the rich tertiary insect beds of the west, and of the fossil insects in the arctic tertiary and cretaceous formations. Until then we must regard all foundations for these hypotheses as laid by the fossil botanist.

ON THE STATUS OF ARISTOTLE IN SYSTEMATIC ZOOLOGY.

BY THEODORE GILL, M.D., PH. D.

SUCH extravagant claims have been urged in favor of the recognition of Aristotle as an exponent of classificatory science, and as a model meet to be followed by the naturalists of the rising generation, that it may be timely to inquire into the merits of such claims, and whether they are really justified by his works. In doing so we must, of course, in justice to the ancient author, exclude from con-

sideration the results of accumulation of data by various workers, which have culminated in the recognition of the valuation and subordination of groups now prevalent, and limit ourselves to the inquiry whether there was aught, either in the spirit or the method of inquiry exhibited in Aristotle's works, or in any of his conclusions, far in advance of his own age and transcending (as has been urged) even the fruits of the researches of Linné and later writers. And inasmuch as the mammals are the best known, and most familiar to the naturalist as well as layman, the treatment of the members of that class may be examined, and it may be regarded as tolerably certain that if ill fortune has resulted in their case, it has, to even a greater degree, in others: and, as a matter of fact, such has resulted in other cases, but the reader will have to take for granted that the writer has satisfied himself of the fact. If the statement should be gainsaid, he is prepared to prove the truth of the assertion; meanwhile, proof is only offered affecting the classification of the mammals. The references to the book, chapter, and paragraph where are found the assertions commented upon, will enable verification (or correction) to be readily made. The principal claims in behalf of Aristotle affecting the mammals are the following:—

1st. The complete and scientific recognition of the class as now limited.

2d. The recognition of relations based on scientific induction and knowledge of homologies.

3d. The recognition of natural groups (families, orders, etc.) as now understood.

4th. The appreciation of the principles of classification; or, in other words, the subordination of values of such groups.

These may be examined in the order enumerated.

1. Recognition of the class. It has been urged that the full recognition of the class of mammals was attained by Aristotle; that, in fact, "The Zootoka of Aristotle included the same outwardly diverse but organically similar beings which constitute the Mammalia of modern naturalists."*

It is quite true that all the mammals were recognized as Zootoka (or viviparous), but so were other animals, and the adjective was not restricted to the mammals. In reference to reproduction, Aristotle has simply remarked, as matters of ordinary observation,

*Owen (R.) On the classification. . . of the mammalia. . . 1859, p. 1.

that animals are viviparous, oviparous and vermiparous. Such a distribution would naturally occur to one who had observed a number of facts, but very little scientific knowledge would suffice to correct the erroneous first impression.

Further, among the viviparous animals are included man, the horse, the seal,* and others with hair; and among marine animals the cetaceans, but so are also the *Selachians* (I, iv, 1) and, in another chapter (I, vi, 2), the viper is added. He makes, it is true, a distinction between such as are *internally* viviparous and oviparous (I, iv, 2) for he had not conceived of the possibility of the truth embodied in the aphorism "*omne vivum ex ovo*" but there is no evidence that he had any conception of the significance of the character observed, or that if called upon to subordinate the groups of animals, he would have classed them otherwise than ordinary observers of the same facts would have done and, in numerous cases and with knowledge of the same facts, did afterwards: it is at least, an assumption which is even negatived by other observations of Aristotle, and rendered improbable by our knowledge of the operations of the mind exhibited by others in the classification of facts.

If, on the one hand, Aristotle appears to recognize, in the statement that the Selache are viviparous fishes (VI, x, 1), that the Cetaceans are not fishes, but a peculiar group (I, vi, 1) like birds and fishes; on the other hand, by direct association of them with Selachians as viviparous aquatic animals (VI, xi, 4) and their contradistinction from viviparous animals with feet and from man, as well as from the oviparous fishes, he removes them to a still greater extent from the ordinary mammals † and raises a doubt what really were his ideas as to their relations.

2. Recognition of homologies.—Although recognizing homologies in a vague manner (I, i, 3, 4), as any one capable of thinking and expressing his thoughts must do to a greater or less extent, his appreciation rarely advanced much if at all beyond the popular views, and he frequently confounded the relations of true homology and analogy, putting, *e. g.*, in the same category, the relation of the nails and hoofs of ordinary quadrupeds and the nails of the

* The seal, in another place (where it is also said to have cartilaginous bones) (VI, xi, 3), was associated with the cetaceans, as were also the sawfish (Pristis) and βοῦς (Ceatoptera?) (VI, xi, 1.)

† Oviparous vertebrates are interposed between the two categories.

human hand, and crabs' claws (I, i, 4). Deceived by the inclusion of the proximal joints of the members within the common abdominal integument and the elevation of the heel and carpus, in most mammals, he adopted the current view that all animals, except the elephant, differed from man in the contrary flexures of the limbs, having the joints of the fore limbs (really the carpus) directed forwards and those of the hind limbs (tarsus) directed backwards (II, i, 4). His observations of monkeys, which would have enabled him to add other exceptions to the elephants, were even forgotten for the time being in these "generalizations."*

A still more evident failure to appreciate correlation of structure is exhibited in the statement that the lion has no vertebræ, but only one bone in the neck (II, i, 1), and yet no one — certainly no one habituated to comparison of things — could look upon that animal without perceiving the likeness to the cat,† and it might also be supposed that the very movements of the beast, or natural deductions concerning them if it had not been seen alive, based on the knowledge of the necessities of animal life and animal mechanics, might have prevented the reception of such strange ideas.

3. APPRECIATION OF GROUPS.— Among the multifarious objects of which the sense of sight takes cognizance, there are many so much alike that they are at first naturally confounded; and intellectual acumen is exhibited, not in synthesis or the appreciation of the resemblances, but in analysis or perception of the differences: especially is this the case, when the like forms are contrasted with others; the differences are then still more lost sight of and overshadowed by the closer common bond coming into bolder relief in contrast with the unlike. For example, it requires no penetrating acumen to recognize man, the monkeys, the bats, the typical ruminants and the typical cetaceans as distinct forms existent in nature. But such are fair examples of the groups for the appreciation of which Aristotle has been so highly lauded,—groups which from their very nature in their integrity first appeal to the senses, and which only minute analysis enables the observer subsequently to differentiate into ultimate constituents.

4. SUBORDINATION OF GROUPS. — If, too, modifications of the

*In another place, he recognized the homologous relations of the members in man and the monkeys, remarking that both the arms and legs are flexed as in man, and curved towards each other. (II. v, 3.)

†Yet Aristotle does not seem to have recognized this relation, as he remarks that the lion's internal parts, when exposed, resemble those of a dog.

members are to be considered, it would be rather a person of peculiar idiosyncrasy whose attention would not be first arrested by the characters exhibited by man (biped), quadrupeds, and whales (fish-like and without hind limbs).

Equally probable would it be that, when examining the feet of quadrupeds, his attention would be first arrested by the differences seen in the hoofed and unguiculate mammals; and if, further, the former were studied, the cloven hoof of the ruminant, the solid one of the horse, and the divided one of the elephant would be equally likely to first attract attention. And yet these obvious points of structure are almost the only ones noticed by Aristotle. He made no attempt to coördinate them, to subordinate the groups so distinguished, or to assess a taxonomic valuation on characters or groups; in brief, there is no evidence of definite ideas of classification having occurred to him. It may, indeed, be well believed that some indistinct perception of system must have flashed upon the mind of such a man, but the impression was too undecided and intangible to be seized and embodied in a system.

Those groups which Aristotle recognized are the crude materials with which the naturalist has to deal. He was unacquainted even with the characters which furnish the criteria for classifying them, and to assign to him any definite views respecting their relationship is an anachronism and may involve a wrong to himself.

In fine, there is, so far as I can perceive, not the slightest evidence of any recognition of what is now understood by classification in any of the extant treatises of Aristotle on animals, and the systems framed to embody his generalizations have been constructed from isolated sentences wrested from their context and simply reflect the framer's notions or his ideas as to what Aristotle might have supposed.

And, as a hearty admirer of the great philosopher (more excellent in intellectual than in physical science), I may claim a right to protest against systems (like that, *e. g.*, published by Macleay) which have been fathered upon him; I may assume that had his attention ever been challenged, he might have better appreciated the relations existing between the groups which he, in common with daily observers, perceived.

Careful and repeated perusal of Aristotle's biological treatises have, in fact, failed to convey to the writer any impression save

that he was a tolerably good observer and compiler, and surpassed ordinary men, perhaps, in ability to embody in words the results of his observations of various disconnected facts. There is, however, no coördination of the facts observed, no valuation, and no subordination which would entitle his observations to be considered as a body of scientific facts or doctrine. The materials for science exist indeed, but in a very crude and imperfect condition. Commendation of his work as a model of scientific treatment betrays a phase of mind and appreciation which is not readily comprehensible, and has only found expression in vague eulogy without proffer of the proof or basis for the encomiums. It need only be added that in this opinion I essentially agree with some of the best qualified students of the works of the great Stagyrite. Of these, I need only mention especially the several treatises of Dr. Whewell,* the great master of Trinity college; Prof. Carl Sundevall† who has published a commentary on several of the classes treated of by Aristotle; and Mr. George Henry Lewes‡, who has devoted a special work to an examination of Aristotle's various treatises. The verdicts of these gentlemen are pertinent and amply justified, I think, by the facts. The same can scarcely be said of the censorious criticism of the Grammarian of the Deipnosophistæ,§ or of the illustrious advocate of the inductive method‖, but even their judgments, or at least that of the last, are the natural result of antagonism to the opposite extreme.

At a future time, I may perhaps publish an analysis of the four capital propositions ascribed by Cuvier to Aristotle.

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*Whewell (William). History of the inductive Sciences, from the earliest to the present time. . . . . [Various editions, book xvi, chap. 6.]

—— —— [On the Philosophy of discovery, chapters historical and critical . . . . London: John W. Parker and Son. . . . . 1860. (pp. 23-78.)]

†Sundevall (Carl Johan) Ett försök att destämma de af Aristoteles omtalade Djurarterna. . . . Första afdelningen: luftandande djur, eller Klasserna: Däggdjur, Foglar, Reptilier och Inseckter med Arachnider . . . . Stockholm . . . . 1862 . . . . [4to, 148 pp.] < Kongliga svenska Vetenskaps-Akademiens Handlingar. Ny följd. iv, 1864.

—— —— Die Thierarten des Aristoteles von den Klassen der Säugethiere, Vögel, Reptilien und Insekten . . . . Übersetzung aus dem Schwedischen.—Stockholm, 1863, bei Samson Wallin. [8vo, 242 pp.] A translation, edited by the author, of the preceding.

‡Lewes (George Henry). Aristotle: a chapter from the history of science, including analyses of Aristotle's scientific writings. . . . . London: Smith, Elder and Co., ... 1864.] 8vo. x, [1] 404 pp.] (see, especially, pp. 269-279.)

§Athenæus. Deipnosophistæ, Book viii, c. 47-50.

‖Bacon (Francis *Lord*). Novum Organon, [various editions, Pars I, Aph. lxiii,] etc.

SENSITIVE STAMENS IN PORTULACA.

BY PROFESSOR C. E. BESSEY.

Two years ago my attention was first called to the sensitiveness of the stamens of *Portulaca grandiflora*, by observing a peculiar motion in them, while a small wild bee was engaged in gathering honey, and perhaps pollen, from the flowers. Upon trial I found that I could, by touching the stamens, make them move through quite considerable arcs of circles. I pursued the investigation somewhat farther at the time, but on account of a pressure of work was compelled to drop it. Last year I again made some examinations which confirmed my previous observations, but declined calling special attention to the facts until I had had opportunity for examining Claytonia as well. This last I have been enabled to do this spring, and having now again verified my observations on the Portulacas can give the results.

In both the common species of *Portulaca* i.e., *grandiflora* and *oleracea*, if the stamens are brushed lightly in any direction, they will immediately with a strong impulse bend over toward the point from which they were brushed; for example, if a pin be made to pass through the stamens from left to right, they will bend from right to left; if the direction of the pin be now reversed so as to pass from right to left the stamens will spring back from left to right, and this reversal of motion may be continued for some time, of course with diminished energy. The motion seems to be induced by a *pushing* or *bending* of the stamen, as simply touching it appears not to affect it at all, and the direction of this motion seems to be determined by, and always *contrary* to, the pushing and bending. The object of this is, I think, evident. When a small insect visits the flower and struggles through the thicket of stamens, as it bends them away from itself, they will react and bend closely against the sides of the insect's body, covering it with pollen, which will be thus carried from flower to flower. Thus far I have not noticed any special arrangements for providing that the pollen of any flower shall not fertilize its own ovules; nor have I found any contrivances for certainly making the pollen deposited on the body of an insect come in con-

tact with the stigmas of the next flower visited. The stigmas are however raised considerably above the tops of the stamens, which *may* sufficiently guard against self-fertilization, and as they diverge quite widely it is *possible* that they are touched by insects before the stamens are.

Hoping to get more light on this point I examined with much care a large number of flowers of *Claytonia Virginica* with the following results:

The stamens of Claytonia (this species, at any rate) are not sensitive,—or at least not appreciably so. They however have a motion which appears to accomplish the same probable result, namely, the securing of cross-fertilization. When the flower first opens, its five stamens rise parallel with the three cleft style, and at this time the anthers may or may not be shedding their pollen, but *the stigmas are closed*, the three stigmatic surfaces being closely applied to each other so that the style appears as if entire and single. After an undetermined time the lobes of the style begin to diverge, and the stamens then, or a little before, recede, so that when the stigmas are fully exposed the anthers are turned back as far as the opposite petals will allow them to be. In the majority of cases the stamens seem to bear with considerable force upon the petals, the anthers touching nearly the middle point of the petals, while the filaments are arched as in *Kalmia glauca*.

From my observations I am led to think that after fertilization has taken place the stamens regain to a greater or less extent their first position—though of this I cannot speak with certainty. The arrangement here seems to be beyond a doubt for preventing self-fertilization, and I have no doubt that had time permitted, some contrivance for securing the interchange of pollen would have been found. This must however be left for the next spring's examinations.

STRIÆ ON MOUNT MONADNOCK.

BY G. A. WHEELOCK.

Having in the last three years spent many days in studying the striæ on Mt. Monadnock, the writer is unwilling that the results of his observations should be lost for want of record, especially as they seem to have an important bearing upon unsettled questions of surface geology. This mountain is peculiarly favorable to such study. Its long spurs radiating from a central elevation, although less regular than the points of a star, yet present to four points of the compass long ranges of bare rock, which have recorded the markings of the ice period with all their variations of direction, and furnish a lesson not to be found, perhaps, in any other locality.

To understand fully the meaning of the evidence herein detailed, it is necessary to have a clear idea of the relative bearing and position of these radiating ridges or spurs.

For the sake of clearness of description we will suppose the principal ridge, which runs north 25° east, to be straight, and to be four miles long. This ridge was an uplift, sloping toward the west, and presenting its broken and precipitous face toward the east. It is like a dam set obliquely across the current of the northern drift, and its serrated edge rises from fifteen hundred to two thousand feet above the surrounding country, growing higher from each end toward its central parts. If we suppose a section of this range near the centre to be pushed some fifty rods farther west, and elevated to the height of three thousand two hundred and eighty feet, we shall have the summit of Monadnock. A short spur projects west of the summit about a mile, and divides into two branches; these we will call the west and northwest spurs. The two ends of the dam we will call the north and south spurs; these with the western spur and its northwest fork complete the outline of the mountain, making four radii.

Numerous observations of the direction of drift striæ made in the adjoining towns show very general uniformity. They have a range of not more than 15°, varying 15° west of north to north and south. On the summit of Monadnock the direction varies within the same limits. Only one set of striæ were noted there

as 5° east of north. So too, following along the northeast spur, there is no change in the striæ so long as the altitude remains the same. The crest is all naked rock for two miles and a half, or three miles, and frequent observations can be made. Just as fast as the ridge falls off in height the striæ gain a more westerly direction, becoming 15°, 20°, 25° west of north; where the rocky ridge terminates and is succeeded by open pastures, 30°, and in many places 40° west, were noted as common. Appearances indicated a local deflection of a current around the northern end of this long dam.

Although a special expedition was made to what I have called the northwest spur, the lower portion of it was so much covered with drift that few exposed places could be found; some five or six however, and all that were noted, showed striæ north 25° east. All the higher portions of the ridge were striated like the summit and the ridge before described.

Another day's expedition was made to the west spur. Standing on the crest of this lofty ridge and looking toward the south, the view is unobstructed to the horizon. The striæ all along this ridge are innumerable and all north and south. There is no opposing ridge near, to lead one to expect south of this a change in the striæ. On the contrary there is every facility for the drift current after passing this ridge to continue on in a straight course. The southern spur is a mile or more off on our left and presents a high opposing barrier toward the southeast but none toward the south. Why should the drift current after passing this ridge, suddenly turn toward the east and climb the steep and lofty barrier of the south spur? Nevertheless there are indications of just such a change as this.

If we place one foot of a pair of imaginary compasses on the summit of Mt. Monadnock, and with the other strike a curve from the west spur to the south spur, we shall hardly have made a more complete change of direction from one spur to the other, than is indicated by the striæ in the short space of a mile and a half. It is difficult to pass over all parts of the valley between these two spurs, the upper portion of it being extremely craggy or uneven. It is better to go down to the open pastures at the base of the mountain. Beginning at the foot of the western spur and skirting the base of the mountain toward the east, the first thing to excite attention is the immense number of bowlders. They exceed in

multitude any other deposit about the mountain, but form no part of its talus, which does not fall on this side. They seem to be in some way connected with the change of the drift current, which began at this place, and with the position of the ridge under the lee of which they lie. Passing through these bowlders which continue for half a mile or more, we come to the first bare ledges; these are marked with striæ, N. 20° W. These are soon succeeded by others thirty, forty and fifty degrees west of north. They may not occur all in regular order; on some ledges there are two or three sets of striæ of different angles. Proceeding a mile and a half we arrive at the easterly slope of the south spur near the Mountain House. The road to this house was built north and south on sloping ground, and for half a mile the fresh surface of the rock was in many places exposed to view. It is everywhere scratched and polished. These scratches vary from 50° to 60° and 70° west of north. Climbing the slope of the ridge, everywhere the exposed prominences of rock are embossed in the same direction. Arriving at the crest of the ridge, it is everywhere serrated and uneven.

On this height we again overlook the whole country. Here on the narrow crest of the ridge the striæ are very generally north 40° or 45° west. In one place an angular trough perhaps twenty feet long and six feet deep runs across the crest. In this there are long continuous striæ due east and west. They appear to be exceptional and suggest the idea that this shallow trough had been able to control and change the direction of the striating force. Standing on this ridge and looking toward the east, we see that the mountain on this side is very precipitous, and that probably there are no striæ on its broken surface. Higher up the mountain, within a thousand feet of the summit, the striæ are 35° and 30° west of north; lower down at the extremity of the south spur, the end of the long dam, they vary from 40° to 25° west of north. What kind of striæ should we expect to find under the lee of this four mile breakwater? Another expedition and another day were required to answer this question. The country east of the four mile ridge is mostly wooded and difficult to traverse. The rock is mostly covered with drift. Beginning at the south end and travelling north, no striæ were found until two-thirds of the distance had been passed over. Curiosity was at last gratified by finding large flat surfaces of naked rock scored all over with long parallel

lines much better preserved than those on less wooded and more exposed parts of the mountain. It would be difficult to decide what was their prevailing direction. Multitudes ran due east and west; some few north and south; some north 10° west; some north 10° east; many north 70° and 80° west; many north 70° and 80° east. No theory of mountain slides could explain this remarkable scratching; the situation seemed to forbid such an explanation. These observations were made on many different ledges, but all of them within a half mile of each other, and within a mile of the north end of the ridge. When a rapid stream with a current of three miles an hour passes a rock in its bed, water will flow around the rock and meet on its lower side. Do not these irregular striæ indicate a changeable and eddying current inconsistent with the motion of a glacier?

Mt. Monadnock furnishes some suggestions also on the subject of erosion. Chemical agency and the action of frost may properly enough account for a large amount of rock disintegration. On long lines of coast the ceaseless waves of the ocean cause an endless amount of erosion. But the amount of actual planing and grinding of the earth's surface by icebergs or continental glaciers seems somewhat speculative and furnishes small means of measurement. Whoever has had experience in grinding and polishing mineral specimens knows full well that, so long as there are protuberances or cavities on the surface he is grinding, he has accurate means of judging his rate of progress. But when he is grinding a flat surface, he has no means of judging from the surface itself. So here on a large scale, all along these naked mountain ridges there are rounded angles and mammillary protuberances of all dimensions, which are marked with striæ, but have never been ground down to a flat surface. They are rounded, scratched and often polished. Is it not possible to reconstruct the angles and edges that are worn off and thus have an approximate measure of ice erosion? On a hill in Keene there are acres of hard quartz rock lying uncovered and much exposed to glacial action. The rock is composed of laminæ an inch thick, and these incline toward the south. When the rock is fractured obliquely, the fracture is interrupted by each lamina, so that the edges of the laminæ project slightly like the serratures of a file. Now all over these sharp serratures there has been much grinding and polishing, but the shallow cavities originally between them have rarely

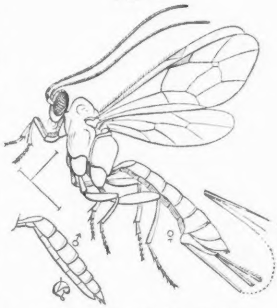
ly been ground out, and there is no reason for supposing that this hard rock has ever been eroded more than half an inch. On Monadnock, where the rocks have a regular jointed structure and the upper edge alone has been worn off, it is often easy to supply the lost angle, by reproducing the contiguous sides. Studied in this method an erosion of one or two feet would be as much as is indicated on all the higher portions of the mountain. On lower ground surfaces are more flat and judgment is at fault. Between the northwest and northeast spurs a wide valley opens out toward the drift current. This extended valley is filled with mammillated rocky protuberances projecting among the spruces which grow everywhere between them, from six to ten feet high. This valley is in the line of the drift and would be eroded if any place would, but the protuberant rocks seem merely to be rounded and the roughness of original fracture worn off.

A few words about the erratic bowlders in this vicinity may not be irrelevant. There are bowlders here of a phonolitic character, which often contain black porphyritic pebbles fused into their substance, making them very easy of identification. These have been a subject of special study, and some fifty of them have been found in Cheshire county. Prof. Charles H. Hitchcock, who is intimately acquainted with New England rocks, says he has never seen such rocks, in place, anywhere, except in the vicinity of Ascutney, Vt. Ascutney mountain was thrown up in a state of fusion, and its heat melted this conglomerate which lay close by it. Ascutney is about fifty miles from Monadnock and north 10° west. Two of these bowlders lie at the base of the Monadnock. There is one in Keene that must weigh one hundred tons. Many were found near together or in the same line; but many more show a great lateral divergence. Keene is forty miles from Ascutney, and in that distance many bowlders have diverged eight miles, or one mile in five from the starting point. These bowlders have been dug out of the drift at various depths. While it is difficult to imagine a continental glacier making so many and such wide diverging lines, it is also difficult to understand how icebergs could have picked up these bowlders and polished their hard material on so short a journey.

REVIEWS AND BOOK NOTICES.

ENTOMOLOGY IN MISSOURI.*—Not only is this report of much interest to the farmers and gardeners of the State of Missouri, but naturalists will glean from its pages some facts new to science. We may congratulate the citizens of Missouri on the publication of an official report, which is of a high economical interest, and is an estimable contribution to science. And while thrifty habits are suggested, many a farmer's boy is acquiring an interest in insects and their ways, that will surely lead him to observe facts for himself in after life. His judgment will thus be trained, and he will be a better farmer and a more trustworthy citizen. Hence these reports have a distinctive educational and moral bearing on the citizens of the state in which they are published. We shall now attempt to give our readers some idea of the thoroughly good scientific work done by Mr. Riley in his primary attempt at enlisting the interest of agriculturists in observing and restraining injurious insects.

Fig. 115.



Pimpla, parasite of Codling Moth.

After some preliminary remarks on insects and economic entomology, with some views on classification to which we cannot give our assent,† several pages follow on the mode of collecting and preserving insects, with full illustrations.

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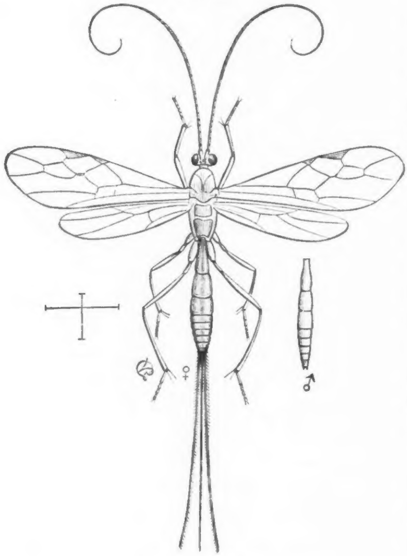
*Fifth Annual Report on the Noxious, Beneficial and other Insects of the State of Missouri, made to the State Board of Agriculture. By C. V. Riley, State Entomologist. Jefferson City, 1873. 8vo, pp. 160. With cuts.

†For example, Rolleston was by no means the first to divide Articulata into Arthropoda and Vermes; it was done by Siebold in 1848, long before his work appeared.

As morphology indicates by the presence of four pairs of jointed appendages in the head, and embryology demonstrates by their early presence four rings in the head, our author's definition of an insect as 13-jointed does not express the whole truth. He should say 17-jointed, or 14-jointed, counting the head as one, in a popular report of this sort. Four rings can be demonstrated in the head of an insect as easily as that the petals of a flower are modified leaves. Mr. Riley also takes a back step in classification in separating the Strepsiptera from the Coleoptera, the fleas from the Diptera, and the Thysanoptera from the Hemiptera. It is strange if over thirty years of observa-

Two ichneumon parasites (Fig. 115, *Pimpla annulipes* Br. and Fig. 116, *Macrocentrus delicatus* Cress.) have been discovered attacking the codling moth, while ants, cockroaches, and the larvæ of certain predaceous beetles (*Trogosita nana*, etc.), play no unimportant part in destroying the well known apple worms.

Fig. 116.



Macrocentrus, parasite of Codling moth.

We have farther information concerning the grape Phylloxera. Mr. Riley offers the opinion that the mortality among the grape vines in this country for two or three years past may be due to this insect, and from the statements he makes we should judge that he is correct, and if so every vine grower must make himself as familiar with the habits of this insect as he now is with the manure he uses upon the vines, or the mode of training and pruning them.

The Phylloxera is found as far west as Manhattan, Kansas, and as far south as Florida. In Europe it is spreading in Portugal and Switzerland, and in some parts of Germany, while in England it is doing serious injury to hot-house grapes. In France so threatening has it become that the French Academy of Science has a standing Phylloxera committee, and M. d'Armand, at one of its sittings, demanded that the premium of 20,000 francs, offered

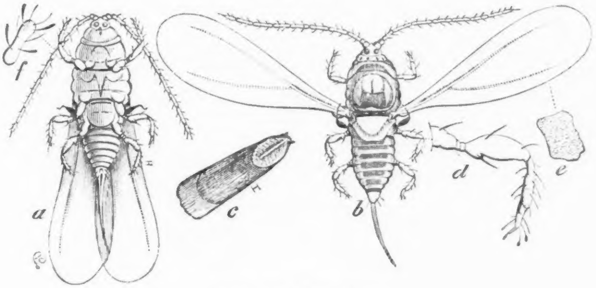
tion should not enable us to advance beyond Westwood's classification, admirable in 1840, but in many respects obsolete in 1873.

Again, our author states that embryological data "though of great value as pointing to the derivation of insects—their homologies and relations to the past—do not always subserve the best interests of classification." We would inquire what is classification but an attempt at tracing the genealogy of animals or plants?

by the government for a remedy, be increased to 500,000, or if necessary to 1,000,000 francs.

The accompanying figure (117) represents the male of the apple bark louse, which Riley calls *Mytilaspis pomicorticis*, regarding it

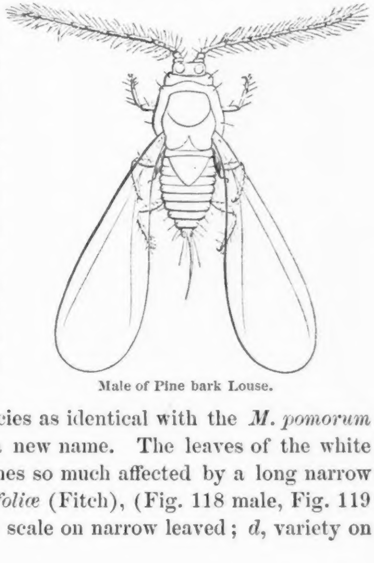
Fig. 117.



Male of Apple bark Louse.

as distinct from the *A. pomorum* Bouché of Europe, from the fact that the eggs of the European species are reddish-brown, while those of our species are white. Care should here be taken in ascertaining how soon after being laid the eggs are observed, as they may vary in color with the age of the embryo within. Certainly we have been unable to detect any difference between the bark louse of the apple as we have observed it in Jena, Germany, and our species, having compared numerous specimens of both. Undoubtedly our species has been imported from Europe, and it would have been the better way,

Fig. 118.

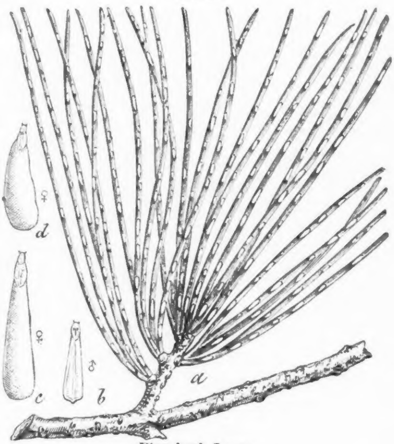


Male of Pine bark Louse.

we think, to regard our species as identical with the *M. pomorum* (Bouché) than to give it a new name. The leaves of the white and other pines are sometimes so much affected by a long narrow bark louse, *Mytilaspis pinifoliæ* (Fitch), (Fig. 118 male, Fig. 119 *b*, the male scale, *c*, female scale on narrow leaved; *d*, variety on

broad leaved forms of Pinus) as to kill the tree. The male (Fig. 118) differs from the male of the apple bark louse in being of a uniform orange-red. The species is double brooded, while the apple bark louse has but a single brood in a season. Drs. Fitch and LeBaron, as well as Mr. Riley, seem only to have found it on cultivated pines, but we have found it frequently in June of the present year on the leaves of the white pine at Brunswick, Maine.

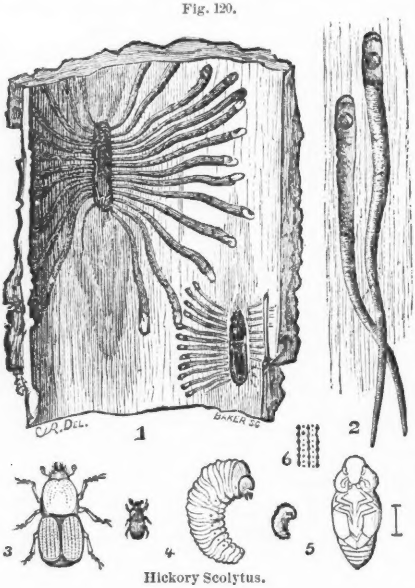
Fig. 119.



Pine bark Louse.

We then have an account of the habits and transformations of *Scolytus caryæ* Riley, the hickory bark borer (Fig. 120, 1, burrows of young larvæ, which afterwards run lengthwise along the bark 2; 3, beetle enlarged and of natural size; 4, larva; 5, pupa.) It infests the hickory, pecan and other species of Carya.

Fig. 120.



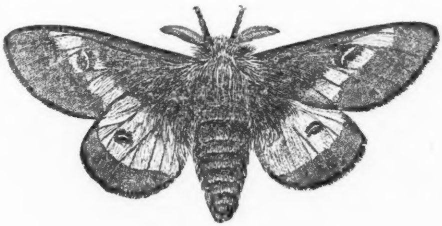
Hickory Scolytus.

The chapter on stinging caterpillars is in the main corroborative of Mr. Lintner's interesting remarks on this subject. One of the most prominent of these larvæ is that of *Hemileuca Maia* (Fig. 121 male, Fig. 122, eggs, Fig. 123, larva,

b, pupa, *c–g*, different spines). Another is the Io moth (Fig. 124 male, Fig. 125 female, Fig. 126 larva, Fig. 127 spines).

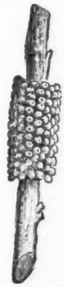
Appended to the report is an article "On a New Genus in the Lepidopterous family Tineidæ: with remarks on the Fertilization

Fig. 121.



Hemileuca Maia.

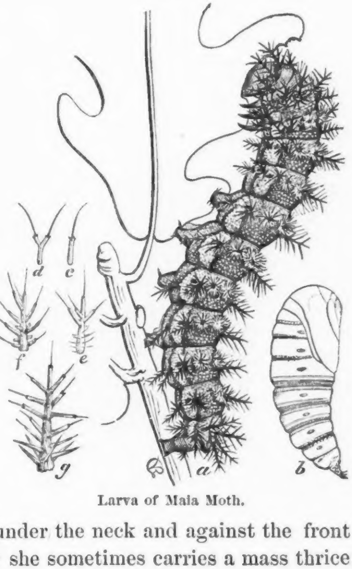
Fig. 122.



Eggs of Maia Moth.

of Yucca." This insect is called *Pronuba yuccasella*, and its appearance and structure may be learned from an examination of the annexed drawings (Fig. 128, *a*, larva, *b*, *c*, moth, *d–k*, head and details of larva; Fig. 129 shows the strange form of the head; *b*, maxillæ and their palpi, *e*, a scale, *f*, a leg, *g*, labial palpus, *h*, fore, *i*, hind wing; Fig. 130, pupa of male and female). Dr. Engelman had drawn attention to the fact that the yucca is incapable of self-fertilization, and Mr. Riley acquaints us with the yucca moth which effects it. He observed that at night "with her maxillary tentacle (Fig. 116), so wonderfully modified for the purpose, she collects the pollen in large pellets, and holds it under the neck and against the front trochanters. In this manner she sometimes carries a mass thrice

Fig. 123.



Larva of Maia Moth.

the size of her head (Fig. 129 *a*1). Thus laden, she clings to the top of the pistil, bends her head, thrusts her tongue into the stigmatic nectary, and brings the pollen-mass right over its mouth. In this position she works with a vigor that would indicate combined

Fig. 124.

Hyperchiria Io male.

pleasure and purpose — moving her head and body from side to side, and apparently making every effort to force the pollen into the tube. Such is the method by which our yuccas are fertilized."

Fig. 125.

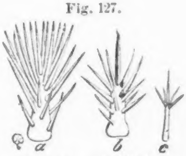
Hyperchiria Io female.

Riley thinks that the eggs are thrust into the fruit "from the side or from the stigmatic opening, following, most probably, the course of the pollen tubes." In a day or two after the flowers have withered the young fruit contains generally two young larvæ.

Fig. 126.

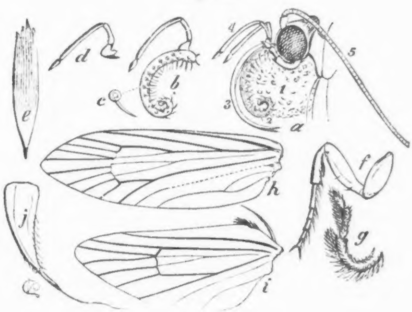
Larva of Io Moth.

Fig. 127.



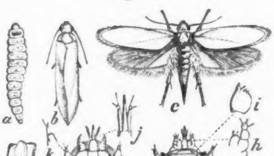
Spines of Io Moth.

Fig. 129.



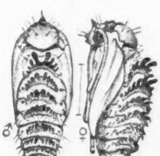
Yucca Moth, details.

Fig. 128.



Yucca Moth, larva, etc.

Fig. 130.



Pupa of Yucca Moth.

NOXIOUS, BENEFICIAL AND INJURIOUS INSECTS OF MISSOURI.

The Tineids of North America.* — Our gratitude is due to Mr. Stainton for this kindly act of international courtesy in preserving in a permanent form the part of Dr. Clemens' scientific writings (and they were all confined to the Lepidoptera) relating to the family of Tineidæ. Dr. Clemens was fortunate in the beginning of his studies, in the friendship of so able a naturalist and kind a helper as the editor. For our part, who owe so many favors to Dr. Clemens, and also have derived so much aid and stimulus from Mr. Stainton's works, we appreciate fully this mark of friendship.

Little new matter, but a number of new woodcuts appear, from Dr. Clemens' pencil, being mostly outlines of the venation of the wings of these small moths. Nine letters to Mr. Stainton, and a few pages of other matter, are added to what has already been published in the Proceedings of the Academy of Natural Sciences, and the Entomological Society of Philadelphia.

BOTANY.

On Cross-fertilization as Aided by Sensitive Motion in Musk and Achimenes.— The sensitive motion of *Mimulus* has been well known, at any rate, since the time of Sprengel, who curiously enough includes this proper motion among those to account for which he says "we are obliged to suppose an internal impulse, a force independent of external influences.† In this category he places the stigmatic movements of *Mimulus*, *Martynia*, and *Scævola*, and the movements of the stamens in *Parnassia* and other plants. The object of the movements of the stamens in *Parnassia* was already connected in his mind with that of insect agency, and this has since been conclusively established by other botanists.‡

I am not aware that a like connection has been noticed between the stigmatic movements of musk, and the necessity of insect fertilization. Vaucher remarks that during *the time of fecundation M. luteus* and *M. glutinosus* will, as he himself has tried, close at

* The Tineina of North America, by the late Dr. Brackenridge Clemens. (Being a collected edition of his writings on that group of insects.) With notes by the editor, H. T. Stainton, F. R. S., London, 1872. John Van Voorst, 8vo. pp. 282, with woodcuts.

† Sprengel's "Anleitung zur Kenntniss der Gewächse," part i, p. 274.

‡ See A. W. Bennett's paper in Journ. Linn. Soc., vol. xi. p. 26.

the slightest touch. The sensitiveness will be seen to play a useful part in this fecundation.

I will take the commonest species, *M. moschatus*, as a type. The flowers vary from erect in the bud to horizontal in the full blown flower, but never hang downwards. Of the four stamens the anterior, lower, and larger pair ripen after the posterior, upper, and shorter pair. Both pairs of anthers are held together by hairs, and the longitudinal slits of the anther open towards the lower lip, and away from the base of the flower. The style is closely pressed against the upper lip of the corolla, and its stigma has two large flat fan-shaped lobes. In a very young bud these lobes are closed. In a hardly opened bud the lobes are beginning to open, the lower one bending back against the style; at this time it is that the shorter stamens burst, but as they are much shorter than the style the pollen cannot reach the stigma, and its course down the tube is facilitated by the, at that time, slanting position of the flower. In a just opened flower the stigmas are fully open, parallel, and opposite to the lower lip of the corolla, its viscous surfaces being therefore both downwards; the shorter anthers are nearly empty, and the longer only just beginning to split; the pistil is therefore synacmic with the shorter, and almost protogynous with respect to the longer stamens.

In a flower almost beginning to fade the longer stamens are still shedding their pollen, the shorter ones are withered, and the stigma be-pollened and in many cases closed. This closing may, moreover, be experimentally produced by touching the stigmatic surface with a pencil, in which case the stigmas will close in about thirty seconds. In faded flowers, whether from contact or otherwise, the stigmatic surfaces have closed.

From these facts it will appear that self-fertilization by the shorter stamens is impossible, and that it is rendered improbable by the longer stamens (1) by their bursting late; (2) by the direction in which the anthers open; (3) by their not reaching as far as the stigmas, and, as being anterior, by being some slight distance from the upper lip; (4) from the probability that the stigmatic surfaces may have been touched and closed before they burst at all.

On the other hand, an insect attracted to the flower for the honey could hardly leave the flowers without some pollen on the upper side of his body or on his proboscis. The hairs which hold

the anthers together no doubt facilitate this, as they do in *Pedicularis*, by keeping the stamens from separating. The large size of the stigmatic surface will of course increase the chance that any insect with pollen on its proboscis or back will not fail to leave some grains attached to it as he works his way towards the bottom of the flower.

But what purpose does the sensitiveness serve? To prevent the stigma being fertilized by its own pollen by insect agency. Without this sensitiveness why should not an insect covered with the pollen of the shorter and synacmic stamens leave the pollen on the stigma of the same plant as he backs his way out? Given the sensitiveness, this is impossible, for as the insect passes under the stigma the sensitive motion is excited, and while he is drinking the honey time is allowed for its completion, or if it be not completed in time, the mechanical effect of the backing motion of the insect will be to complete the closing.

A similar use of a quite different movement has been suggested to me by Miss S. S. Dowson, one of my Cambridge corresponding class. The *Achimenes* (Gesneraceæ) has a tubular corolla five-cleft with a swelling just below the top of the throat. There are four perfect stamens, not much differing in length, and the stigma is ultimately two-cleft. In the bud the pistil is much shorter than the stamens, but by the time the bud is just opened it has lengthened out between the stamens, and its tip is adpressed to the upper lip of the corolla. As yet the stigma has its two branches closely folded together. The anthers at this time are all four close beneath the end of the pistil, and open downwards. The filaments then begin to contract, and the anthers, which adhere together, are drawn lower; and finally the filaments twist themselves up to such a degree that the anthers are drawn down to the very base of the tube. The object of this is clearly to get them out of the way of the stigma, for during the process the pistil has arched forwards and downwards, and the two branches of the stigma have opened. They will be seen to form a fork over a slight rising in the middle lip of the corolla, by which entrance to the flower, except exactly under the stigmatic surfaces, is prevented.—F. E. Kitchener *in Trimen's Journal of Botany*.

Nardosmia palmata.—Looking over the Naturalist for April, 1872, I find this plant mentioned by Prof. Tenney, as occurring in

Amherst, Mass. with the query "What are the New England localities of this rare plant ?" During 1859-60 I found it in the vicinity of Bangor, Me., on land newly cleared and burnt over, growing as abundantly as erechthites or any of the "fire weeds," many acres being entirely covered with it.

Making a trip subsequently to Mt. Katahdin, nearly one hundred miles north from Bangor, I found it abundantly, at intervals, in clearings, all along the route. But I have never found it elsewhere in New England.—J. W. CHICKERING.

[It is known to occur in Brunswick, Maine.—EDITORS.]

THE USES AND ORIGIN OF THE ARRANGEMENTS OF LEAVES IN PLANTS.—A paper by Chauncey Wright, with the above caption, appears in the last part (vol. ix, part ii) of the Memoirs of the American Academy of Arts and Sciences. It is a philosophical and exceedingly interesting discussion of the subject, and we shall endeavor to bring it to the notice of our readers in a subsequent number.

ZOOLOGY.

SPONTANEOUS DIVISION IN STARFISHES.—Mr. C. Lütken, of Copenhagen, so well known for his important researches on the natural history of certain groups of the Echinoderms, has recently laid before the Royal Academy of Copenhagen the results of some very interesting and valuable investigations on the spontaneous division of the starfishes and brittle-stars. Professor Verrill has recently described a new genus of brittle-star (*Ophiothela*), all the known species of which possess a number of arms greater or less than five, generally six, and in some few instances three or two; very rarely indeed does the normal number of five make its appearance. Lütken describes a new species of this genus (*O. isidicola*) on a certain number of specimens of which he finds six nearly equal arms, but in the majority of these specimens there is a marked difference between the three arms on one side of the body and the three arms on the other; in another set the difference is still more marked, the one set of three arms being quite small and the other of the ordinary size. In others, again, this difference is extended to the disk itself, and it looks as if it had been cut in two by a knife. In all these cases there can be little doubt that these appearances result from a primary division and then a regeneration

of the parts that had been divided off. It becomes an interesting question how often such division could take place in any individual; without being able to pronounce any positive opinion on this point, Lütken inclines to the belief that up to a certain age it can be repeated several times. Allowing that the faculty of regeneration is very great among the ophiuroids (a disk of an ophiura deprived of all its arms will sometimes under favorable circumstances renew them all), still the phenomenon witnessed in *Ophiothela* differs from a mere casual renewal of lost parts of an accidental lesion; there is a regularity and symmetry about it which certainly points to a true natural spontaneous division having for its object the multiplication of the individual. It must not be forgotten, moreover, that Profs. Steenstrup and Sars have observed the same phenomena in certain small ophiuroids with six arms, especially among species of the genus *Ophiactis* that live intertwined among corals and sponges, nor that the truth of their observations has been confirmed by Lütken himself. In one or two species of another genus, *Ophiocoma* (*O. pumila*), the same thing occurs; in these instances it becomes clearly apparent that in young individuals only this agamic form of reproduction takes place, and that with the adult forms the results of the division are truly sexual. Similar phenomena have been remarked in certain *Asteridæ*, notably in *Asterias problema* Stps., and in some allied species described by Verrill, as well as in *Linckia ornithopus* and *Ophidiaster cribrarius*. Lütken is of opinion that though there are many cases where the spontaneous division is merely gemmation more or less disguised, there are likewise many instances in which it is, so to speak, simple division and nothing else. In the case of the ophiuroids and asteroids he inclines to think it a normal form of multiplication, which takes the place of gemmation. It would have a near relationship to the power of regeneration on the one hand, and to that of gemmation on the other; and while it may not always be possible to clearly define the exact limits of these "powers," it is convenient to preserve to "Schizogony" an independent place among the different forms of agamic multiplication. The classifying of the phenomena above alluded to as occurring in the ophiuroids and asteroids in the category of "Schizogony," conclusively indicates, in short, that there is in this spontaneous division something altogether different from gemmation. The following general propositions are laid down by

Lütken: — 1. The most energetic manifestation of the faculty of regeneration in animals is the power of divisibility; 2. In certain forms of Radiates, in which the faculty of regeneration is very highly developed, spontaneous division takes place only, as in ophiuroids and asteroids, or together with gemmation as in Actinia; 3. Actual spontaneous division or schizogony in the Actinia, Medusa, asteroids and ophiuroids, which must not be confounded with the disguised form of gemmation met with in Infusoria and certain heteropods, may be regarded as a peculiar form of agamic reproduction, such as Blastogony, Sporogony and Parthenogony. — *Nature.*

Habits of a Species of Sorex. — As far as my observation goes this is the most diminutive animal among the quadruped type. It is the musk — I had like to have said mouse — but except the incisors, it resembles the Talpa family more than it does the Mus. They are rather rare. Indeed until the present year I had never seen one of them. They dwell in warm nests, made of grass, under rocks, old logs, or old castaway rails, about the fences or edges of the prairie. They do not come about the houses, and are purely nocturnal. I have found only three nests of them. They have four young at a time, which they nurse and care for most affectionately. I had a family of them and fed them a week, where I could observe all their actions. I had the father and mother and their four half-grown offspring. They were pretty pets, and I had hoped to succeed in sending the whole family to you, but our cherished hopes are often frustrated. The male made his escape, and finding another newly married pair — they do marry, and as far as I can learn, stick together as long as they both live — I put them into the box with my half civilized family. The male instantly caught a young one and was aiming to kill it, when I put him and his companion into an empty oyster can, and setting it back in the box, went to supper. When I returned, I found that the ferocious rascally male had made shift to get out of the can, and had murdered all the young ones. I was very sorry for the loss, and thinking he had done all the mischief he could, turned his wife out of the oyster can, and left them in the box with the bereaved and deeply afflicted mother. Next morning I found they had murdered the sorrowing mother and had eaten her very nearly up. These last two captured cannibals I have sent you. The

young are born blind, and remain so until they are half grown certainly, perhaps longer. The male seems to care for and assist in rearing the young. He will go out and capture a grasshopper or cricket, carry it home and give it to his nursing companion. All the actions, one to the other, of a married couple, indicate in the untrammelled state, much affection and caressing attention. No bear or panther could manifest a greater degree of ferocious destructiveness than does the male of this diminutive tribe of animals when he is molested by his kind, or when he comes in contact with a rival. The odor emanating from the box in which I kept them, when the box is clean, is dilute musk, with a slightly sweet accompaniment. They have their young about the 10th of February, that is, as far as my observation goes. How long their period of gestation, or how often they produce their young, is not yet known to me. They sleep all day. I have had opportunity to make observation on the action of four half and four full-grown specimens, some of them through a period of twenty days. The results are recorded above. I wish you to examine them and give me their name and tell me to what families they are allied. —*Abstract of a letter to the Smithsonian Institution by* G. LINCECUM, *Long Point, Texas.*

ALEUTIAN CEPHALOPODS.—In the winter of 1871–2 at Ilinlink, Unalashka, a large number of giant cuttles were stranded at various times. One of these, a species, apparently, of *Pinnoctopus*, measured six feet from tip to tip of the arms, which were much mutilated, or about fifty-two inches from the posterior extremity of the body to the ends of the arms as they remained. The color was white, ocellated with brick-red and the larger suckers measured twenty-five inches across.

A still more remarkable form, however, was subsequently obtained, perhaps the *Onychoteuthis Bergi* Licht., one specimen of which measured from the posterior end of the body to the mutilated ends of the tentacular arms one hundred and ten inches with a body girth of nearly three feet, and weighing nearly two hundred pounds. Another specimen more mutilated measured eighty inches in length. The larger one could hardly have been less than ten feet long when perfect, the pen measuring sixty-one inches. The buccal mass containing the jaws was about the size of a small orange. The *Octopus punctatus* Gabb, which occurs at Sitka abun-

dantly, reaches a length of sixteen feet or a radial spread of nearly twenty-eight feet, but the whole mass is much smaller than that of the decapodous cephalopods of lesser length. In the Octopus above mentioned, the body would not exceed six inches in diameter and a foot in length, and the arms attain an extreme tenuity toward their tips.

There can be no doubt whatever that some cephalopods in the warmer seas attain an enormous bulk as well as length. Capt. E. E. Smith, an experienced sperm whaler, and a careful and intelligent observer, informs me that he has seen portions of "squid" arms vomited up by the whales in their death agony, as large as a "beef barrel," with suckers on them "as big as a dinner plate." I have no doubt of the correctness of this statement. Mr. Henry G. Hanks, of the San Francisco Microscopical Society, reports having seen, when on a voyage in a trading schooner among the South Sea Islands, a cuttlefish near the surface of the water, "as large as the schooner!" While this is rather indefinite still it indicates that specimens much larger than any yet recorded may probably exist in those regions. I have also rather vague reports of some enormous squid which have been observed in the Gulf of California.—W. H. Dall.

Criticism on an Observation of Professor Thomson on Certain Sponges, etc.—On looking over the "Depths of the Sea" by Prof. Wyville Thomson (Macmillan and Co., 1873), my attention was called to an observation which, when taken in connection with what had been said a few pages previously, seemed to me to do great injustice to our distinguished naturalist, Dr. Leidy. In the March number of the American Naturalist for 1870 there appeared "Remarks on some curious Sponges," by Prof. Leidy. In this article, after calling attention to the views of the nature of the sponge, Hyalonema, as offered by Gray, Valenciennes, Milne-Edwards, Brandt, Bowerbank, Schultze, and Ehrenberg, Dr. Leidy observes, "Prof. Schultze regards the sponge mass as situated at the bottom of the fascicle, and its flattened extremity with the large oscules at the base. This appears to me to be the general view, but it has occurred to me that the sponge mass in its natural position was uppermost and was moored by its glassy cable, or rope of sand, to the sea bottom; perhaps to marine algæ. This opinion is founded on the circumstance that in

sponges generally the large oscules from which flow the currents of effete water are uppermost. The ends of the threads of the fascicle, with their reversed hooklets, are also well adapted to adhere to objects." Prof. Leidy, then noticing that the "beautiful Euplectella of the Philippines was also at first represented upside down," concludes by giving a clear description of the Pheronema, a sponge "apparently intermediate in character with Hyalonema and Euplectella—(which would) "appear to throw some light upon the question of what belongs to Hyalonema."

The observation of Prof. Thomson, to which I have referred, will be found on page 426, and is as follows: "Perhaps the most singular circumstance connected with this discussion was that all this time we had been looking at the sponge upside down, and that it had never occurred to any one to reverse it." Reading this quotation by itself one would naturally suppose that Prof. Thomson had simply been ignorant of what Dr. Leidy had already published, but at page 418 of the same work, "the Depths of the Sea," in describing a sponge resembling Holtenia, Prof. Thomson remarks "I was inclined at first to place this species in the genus Pheronema, but Dr. Leidy's description and figure," etc. Evidently, then, Prof. Thomson was familiar with what Dr. Leidy had published in reference to these sponges. Why therefore does he unjustly ignore the fact that Dr. Leidy was the first to describe correctly the position of Hyalonema by saying "we had been looking at the sponge upside down and that it had never occurred to any one to reverse it." We trust that Prof. Thomson will now gracefully throw up the sponge.—Henry C. Chapman.

Embryology of the Lepidoptera.—The distinguished Russian embryologist, Prof. A. Kowaleusky, gives us in a late memoir (Embryological studies on Worms and Anthropods, St. Petersburg, 1871), the first definite information we possess as to the mode of development of the Lepidoptera. He finds that development goes on very uniformly in very remote genera. The primitive band is confined to one side of the egg and sinks a little way into the yolk; it is thus an endoblast, as Dr. Dohm had previously stated from the observations of Herold. The outer membrane, which surrounds the yolk, and is developed from the primitive blastoderm (the amnion of most authors), is called the "serous membrane," by Kowaleusky, while the inner membrane, which

arises from the primitive band, and apparently corresponds to the "faltenblatt" of Weismann and others, he calls the "amnion." Scarcely has the primitive band sunk down into the yolk, than it immediately greatly increases in size and length, until from being only twice as long as broad, and confined to one side of the egg, it surrounds the yolk. At this time the segments are indicated, and the rudiments of the appendages of the head and thorax appear. At a little later stage, the rudiments of ten pairs of abdominal feet appear, corresponding to the number of abdominal segments (in Sphinx). Ten abdominal segments may be set down then as the normal number in the Lepidoptera. The embryo with fully formed organs remains surrounded by the yolk, which it "gulps down its mouth parts, which meanwhile have been perfected." It then devours the "amnion," and finally the external "serous membrane." It has now obtained its characteristic colors and hairs, and lies curled up on its ventral side until it gnaws through the chorion and effects its escape from the egg-shell. From Kowaleusky's observations, we should judge that the Lepidoptera at first, though differing in some important respects from other insects, in others develop like Libellula, Telephorus and the Hemiptera and other endoblasts. In this respect, perhaps of not much importance, the development of the Lepidoptera is quite different from that of the Phryganeidæ. This, perhaps, indicates that there has been no genetic relation between the moths and caddis flies. Later, after the germ is formed, with indications of segments, the embryo resembles that of Diptera and Hymenoptera.—A. S. P.

The Purring of the Cat.—Since the vocalization of rodents has lately been a subject of study, it has occurred to me to inquire into that of one of their mortal enemies. Has any one expounded fully the mechanism of the purring of a cat?

The facts are these. The purr is a double or *to and fro* sound; it accompanies the breathing of the animal and is a respiratory phenomenon. It is in fact a vocalization, with the mouth closed. The vibration attending it is felt all over the chest and no farther, except in the throat.

On auscultation of a pussy during the purr, I found a very musical rumbling sound permeating the lungs throughout. Its character is changed, however, when the larynx is compressed; becoming higher as the voice does with narrowing of the glottis.

The vibration is also coarser to the ear in the throat than elsewhere. It reminds one there of the rattle connected with excessive secretion of mucus in the wind-pipe. But, as there is no liquid present, I ascribe the sound principally to a rough vibration of the epiglottis; supplemented no doubt, by an exaggerated vesicular murmur in the lungs, caused by a quivering, semi-convulsive mode of action of the respiratory muscles.

Perhaps all this may be familiar to most people, and I may have been before very unobservant in supposing the purring to be a general tremor of the whole body, having no connection with the breathing process.

Since writing the above note I have looked through a number of physiological works, without finding anything about "purring;" but at last, in the "Cyclopædia of Anatomy and Physiology," find the following remarks (Article Voice, Vol. iv, p. 1490):—

"The whole of the feline order [*sic*] are remarkable for the prominence of the superior ligaments of the larnyx, by which the purring is most probably produced. Vicq. d'Azyr ascribed the purring of the cat to two thin membranes situated beneath the inferior ligaments; but we [J. Bishop] were unable to detect them; nor could Cuvier, Wolff, Casserius and others, succeed in finding them."

This shows that the vocal nature of purring has been observed. I am sorry not to be able to refer to the memoir of Vicq. d' Azyr "On the Anatomy of the Vocal Organs in Mammals," 1779, to find whether he goes into detail in regard to it. Probably, in an anatomical treatise he does not.

THE "WILLOW WANDS" FROM BURRARD'S INLET.—Some peculiar specimens from British Columbia, resembling peeled willow switches were exhibited at the last meeting of the British Association, and were commented on in "Nature" and elsewhere by naturalists, among whom, Dr. P. L. Sclater (on the authority of some sea captain who stated that they were derived from a *fish*) suggested that if the statement were correct they might be the hardened notochord of some unknown fish. Several of the gentlemen referred to suggested that these organisms were the axes of alcyonoid polypes allied to *Pennatula* or *Virgularia*, and Mr. R. E. C. Stearns, in a paper lately read before the California Academy of Sciences, took the same view, suggesting that they might be allied to *Umbellularia*. That this view is the correct one, and

that the supposed fish was only a "fish story," there can be no doubt whatever. Very lately, Mr. Hemphill has forwarded to the California Academy of Sciences some dry *Virgularias* (?) from San Diego, California. Although the genus cannot be determined without alcoholic specimens, yet the axes of these specimens, which are about a foot long, present no differences whatever except in size, from the Burrard's Inlet specimens, of which the Academy possesses a large series. Mr. Hemphill adds in a letter to Mr. Stearns, to whom I am indebted for this information, that these animals, though not attached to anything, are quite hard to pull out of the mud, and that they descend into it at low water, protruding the upper portion of the polypidom only at high water. It is manifestly improbable that the Burrard's Inlet species, which attains an axial length of six feet, can thus conceal itself, and this would confirm the reports which have been circulated here, that it is found only in deep water.— W. H. D.

Absence of Eyes in Crustacea.—In connection with the subject of cave life and the probable derivation of the blind crayfish of Mammoth cave from ancestors able to see, we would refer our readers to the following remarks of Prof. Wyville Thomson in "Nature," May 15, on *Deidamia leptodactyla* von Suhm, dredged in lat. 21° 38′ N., long. 44° 39′ W. in 1900 fathoms. It is allied to Astacus, but differs from all the typical decapods in the total absence of eye-stalks and eyes.

"The absence of eyes in many deep-sea animals and their full development in others is very remarkable. I have mentioned ("The Depths of the Sea," p. 176)., the case of one of the stalk-eyed crustaceans *Ethusa granulata*, in which well-developed eyes are present in examples from shallow water. In deeper water, from 110 to 370 fathoms, eye-stalks are present, but the animal is apparently blind, the eyes being replaced by rounded calcareous terminations to the stalks. In examples from 500 to 700 fathoms in another locality, the eye-stalks have lost their special character, have become fixed, and their terminations combine into a strong pointed rostrum. In this case we have a gradual modification, depending apparently upon the gradual diminution and final disappearance of solar light. On the other hand, *Munida*, from equal depths, has its eyes unusually developed and apparently of great delicacy. Is it possible that in certain cases, as the sun's light diminishes, the power of vision becomes more acute, while at length the eye becomes susceptible of the stimulus of the fainter light of phosphoresence? The absence of eyes is not unknown

among the Astacidæ. *Astacus pellucidus*, from the Mammoth cave, is blind, and from the same cause — the absence of light; but morphologically the eyes are not entirely wanting, for two small abortive eye-stalks still remain in the position in which eyes are developed in all normal decapods. In *Deidamia* no trace whatever remains either of the eyes of sight or of their pedicels."

Ocelli in Butterflies.—Forty years ago, Klug, in a memoir on the occurrence of ocelli in insects, remarked that these organs were not found in butterflies,— "not even in Hesperidæ;" and so far as I know this has been the universal testimony of naturalists. It was therefore, with some surprise, that on removing the scales from the head of *Lerema Accius* ♂, I discovered in the middle of the front, a conspicuous ocellus. Other species were examined with the following result: Ocelli are present in both sexes of *L. Accius*, in the ♂ at least of *L. Pattenii* (no ♀ examined), but in neither sex of *L. Hianna!* I could not find any in the neighboring genera. In the ♂ of *L. Accius* and *L. Pattenii* there is a single ocellus — lenticular and smooth; in the ♀ of the former it is similarly situated, but broken up into three minute raised points, all together equal to the one ocellus of the ♂ and indicating that the latter is composed of three confluent ocelli.

It is not a little remarkable that in other Lepidoptera possessing ocelli, these are always two in number, and situated behind the antennæ, probably (I am unable to examine specimens) upon the vertex. In some Hemiptera, however, the ocelli are found below the eyes, and in others above, so that this feature is not unprecedented. It would scarcely seem as if the position of the ocelli had the same morphological significance as that of the other organs.—S. H. Scudder.

On a Habit of a Species of Blarina. —I recently placed a water-snake (*Tropidonotus sipedon*) of two feet in length, in a fernery which was inhabited by a shrew, either a large *Blarina Carolinensis* or a small *B. talpoides*. The snake was vigorous when placed in the case in the afternoon and bit at every thing within reach. The next morning the glass sides of his prison were streaked with dirt and other marks, to the height of the reach of the snake, bearing witness to his energetic efforts to escape. He was then lying on the earthen floor in an exhausted state, making a few ineffectual efforts to twist his body, while the *Blarina* was busy tearing out his masseter and temporal muscles. A large part

of the flesh was eaten from his tail, and the temporal and masseter muscles and eye of one side, were removed, so that the under jaw hung loose. The temporal was torn loose from the cranium on the other side, and as I watched him, the *Blarina* cut the other side of the mandible loose, and began to tear the longicolli and rectus muscles. His motions were quite frantic,and he jerked and tore out considerable fragments with his long anterior teeth. He seemed especially anxious to get down the snake's throat (where some of his kin had probably "gone before"), and revolved on his long axis, now with his belly up, now with his sides, in his energetic efforts. He had apparently not been bitten by the snake, and was uninjured. Whether the shrew killed the snake is of course uncertain, but the animus with which he devoured the reptile gives some color to the suspicion that he in some way frightened him to exhaustion.—E. D. COPE.

BIRTHS AT THE CENTRAL PARK ZOOLOGICAL GARDEN. — Lion (*Felis leo*). Two cubs born January 25, 1873 (this is the second time that lions have bred on the Park); period of gestation sixteen weeks; the body indistinctly spotted, long black hairs being scattered over the head; born blind.

Lions are more prolific than any other species of Felis; after the first litter the number produced is seldom less than four. It is a well known fact, that these animals breed more freely in travelling menageries than in zoological gardens, the change of air no doubt having considerable influence in producing this result. The Director of the Dublin Zoological Gardens has been more successful than any other Director in Europe in breeding lions. They have never been able to raise young lions in the London Zoological Gardens. Dr. Bartlett, the Superintendent of the Gardens, in a paper read to the Society, says: —

"A very extraordinary malformation or defect has frequently occurred among the lions produced during the last twenty years, in the Regent's Park. This imperfection consists in the roof of the mouth being open. The palatal bones do not meet, the animal is unable to suck, and consequently always dies. This abnormal condition has not been confined to the young of any one pair of lions; but many lions that have bred in the Gardens, and were not in any way related to each other, have from time to time produced these malformed young, the cause of which appears to me quite unaccountable."—W. A. CAMDEN, *Director, Central Park Menagerie.*

Generation of Eels (Anguillæ). — This is a subject that has occupied the attention of naturalists from the earliest dawn of Ichthyology; and its importance, both in a physiological and economical point of view, has always been, and still is recognized. Yarrell, in Jesse's "Gleanings in Natural History," and in the second edition of the "History of British Fishes," Vol. 2, p. 388, expresses his belief, as the result of a close examination of a number of eels, that they are oviparous, producing their young like other true bony fishes; and he refers in support of this opinion, to some Hunterian drawings, on a magnificent scale, by Clift. Dr. Mitchell, too, of New York, coincides strictly with Yarrell. Though hermaphrodites in fishes have hitherto been supposed to occur only abnormally, as in the genus Serranus, they may perhaps be more common and regular than is admitted in the books of comparative anatomy, such as that of Owen, wherein fishes are said to be always diœcious. But now an Italian physiologist, G. B. Ercolani, in the Proceedings of the "Accademia delle Scienze di Bologna," of last December, describes "Perfect Hermaphroditism in the Eel;" the genitals only completely developed at sea during the month of December; ovaries and testes then and there with spermatozoa; and, as he believes, the spermatozoa are discharged into the peritoneal sac, and the ova there fertilized before their emission from the body. This is surely an interesting statement, and in conformity with many facts well known regarding the economy of the eel. But it requires confirmation, and indeed the subject is so very curious and important, that it is to be hoped that ichthyologists on the seacoast will pursue the inquiry to its legitimate conclusion. — *Land and Water.*

Anatomy of the King Crab. — M. Alphonse Milne-Edwards finds that the circulating apparatus of Limulus is more perfect and complicated than that of any other articulate animal. The venous blood, instead of being diffused through interorganic lacunæ, as in the crustacea, is, for a considerable portion of its course, enclosed in proper vessels with walls perfectly distinct from the adjacent organs, originating frequently by ramifications of remarkable delicacy, and opening into reservoirs which are for the most part well circumscribed. The nutritive liquid passes from these reservoirs into the branchiæ, and, after having traversed these respiratory organs, arrives, by a system of branchio-cardiac canals, in a peri-

cardiac chamber, then penetrates into the heart, of which the dimensions are very considerable. It is then driven into tubular arteries with resistant walls, the arrangement of which is exceedingly complex, with frequent anastomoses, and of which the terminal ramifications are of marvellous tenuity and abundance. He has also found, as Prof. Owen had intimated, that the nerves are completely ensheathed by the blood vessels. — *Annals and Mag. Nat. History, Feb.*, 1873.

The Rose-breasted Grosbeak (*Goniaphea Ludoviciana*).—I wish to testify to the benefits this bird confers by destroying the "Colorado Potato Bug" (*Doryphora decem-lineata* Say), cutworms, and other insects. I have often seen the birds feeding in company with robins, bluebirds, orioles, tanagers and other birds, in various parts of the state, where they appear to be abundant, particularly in spring. They frequent open timber, fields and ploughed lots away from travelled roads. Their note resembles that of the scarlet tanager; when flying, the white on the wings causes them to look something like the red-headed woodpecker. I have never known them to eat green peas, as Mr. Allen says that the black-headed grosbeak, their nearest ally, does. — Henry H. Mapes, *Kalamazoo, Michigan.*

Canaries Nesting.—Confined by illness I have for several days watched a pair of canaries making their nest. They are now lining it, using feathers for that purpose, a portion being from their own bodies, though not (I think) purposely detached. The rest are feathers which I have put on the bottom of the cage. I was struck with this observation, that every time a feather was taken to the nest, it was first deliberately dipped into the water cup, then put in its place, when the building bird, most frequently the female, would drop into the nest and then wriggle the body, to give shape to the structure. The soaking of the feathers was evidently a matter of design, namely, to cause them to lie in place, and receive the proper bend from the motion of the bird's body. I think this indicates considerable intelligence in these little pets.—S. Lockwood, *February* 14.

An Aquatic Bombycid Moth. — Mr. Bar of Cayenne has forwarded to the Entomological Society of France, descriptions and specimens of the various stages of an interesting Bombycid. The larva lives under stones in streams and rises to the surface for

transformation. The cocoons are found in clusters floating on the water. Aquatic caterpillars have hitherto been known only in the lower families of Lepidoptera.

THE EDUCATION OF APES. — The following query comes from a "layman," but is worth considering:—

"Suppose a man whose wealth corresponded with his love for scientific investigation, or some liberal institution or government in his place, should commence the following experiment, viz.; the careful education of a family of the most intelligent apes, through generation after generation, with a view of determining whether such a system would result in an increased development of brain, both in size and quality, and in the retention by one generation of knowledge acquired by a former. Of course this must be done in the native land, in a climate adapted to them, and with extreme and constant care, and the result in the life-time of one man might be hardly perceptible. Would not such an experiment, however, be of immense consequence to science however it might result?"

FAULTY INSTINCT IN A CAT.—Having ended some incomplete studies last summer on a pine snake, it became a question how to dispose of it for the winter, so as to have it in condition for renewed observations at the returning season. This was done thus. Its box was neatly covered, and converted into a flower stand, so that in blissful ignorance our lady visitors were not horrified, when admiring the sitting room flora, with any suspicion of a terrible "snake beneath the flowers."

We have a cat, which, already adult, was brought from "The Pines," and doubtless had a knowledge of snakes, probably both by inheritance and acquaintance. Yesterday, March 2d, the reptile set up its peculiar blowing in its dark box. It was a sight to observe the actions of the cat. There was plainly astonishment in that feline pate. She kept her place, turning her head towards the several corners of the room, and listening intently. Still continued that strange blowing of the snake, like a loud wheezing of wind escaping from a rent in a great forge bellows. The cat now fixed her eyes on the box whence the sound came. It happened that a strip of dark colored cloth lay on the box, with a part pendent to the floor. Pussy's mind was made up—that was a snake — nothing surer, for the sound kept steadily coming from that very spot. Now the cat crouched low and crept very slowly indeed, with eyes riveted on the prey. Still the reptile hissed and the cat slowly advanced. Now came a pause of but a second, and

the beast sprang seizing the pseudo-snake. There was an attempt at a shake; but its illusion had vanished. Such a look of silly astonishment and feline disappointment as followed cannot be described. All that can be said is, this new experience had its manifestation. As sometimes with other hunters, pussy's prey was not worth the powder, and she turned away in disgust. The exact nature of her perplexity we cannot know; for still the hissing was kept up. Although decidedly at fault in its attack on the strip of cloth, yet this whole affair seems to me a case of awakened instinct. It is a year and a half since she has been here. How much of recollection of individual knowledge, or experience; and how much of awakened inherited habit, or instinct, and what the concatenation of these things might be in that feline thinking, are perhaps problems to be referred to some future metaphysicist in zoology. One curious habit of this cat deserves mention. Her cry, whether caused by want of food or any other attention, is exactly that of our American puma (*Felis puma* Shaw) popularly known as the panther or painter. I have heard the female puma's cry so piercing and distressing, and the likeness is so close, that the sound of pussy's cry is positively annoying to me. The difference between them is entirely one of loudness. Even the very timbre, or quality of tone is identical. The cat is black and white and in disposition as gentle as others, even showing affection. I ought to say that when a kitten she was a favorite of my lamented friend, that accomplished botanist, the late Dr. P. D. Kineskern, and even in the pains of his departure her kitten gambols on his bed entertained that good and excellent man, who is known in posthumous fame as the philosopher of the Pines.—SAMUEL LOCKWOOD.

VARIATION IN DENTITION.—Mr. Allen and others may be interested in a case showing that even the dental formula, so universally employed in framing generic and higher groups of mammals, is variable, and therefore not always reliable. In the skull of a wolf (*Canis lupus* L., race *occidentalis* Rich., strain *griseo-albus* Bd.,) I find the dentition not only anomalous, but also asymmetrical; there is a supernumerary tooth on the right side of the lower jaw. The extra tooth is a molar behind the last true molar, making three teeth back of the large sectorial one. It is small (about as much less than the last true molar as this one is less

than the penultimate), but well developed, single-rooted, circular, very obtusely conical. There is nothing to meet it above, since it sets entirely back of the upper series. On the other side of the under jaw there is a slight pit in the bone, corresponding to the situation of the extra molar, and showing an ineffectual *nisus* in the same direction. In all other respects the dentition is normal. To judge from a limited experience, this is an uncommon anomaly; I have never before met with it in a feral animal. The preparation (No. 2,728 of the writer's coll.) goes to the Smithsonian. —Elliott Coues, *Fort Randall, Dakota.*

How to Clean the Euplectella.—This beautiful sponge is becoming a favorite, and deservedly, with lady collectors. Its marvellous delicacy and purity, after long exposure without a glass shade, becomes sadly injured by the adhering dust. I had a specimen given me lately, which, from this cause had become so unsightly as to be accounted worthless. I filled a deep jar with water, and stirred into it a good table spoonful of chloride of lime. An hour or so was then given for the lime to settle. After this, the specimen, held by a clean thread, was suspended in the fluid for twelve hours or so. It was then taken out by the thread, and suspended a few hours in clean water. This entirely removed the chlorine. It was then suspended in the air to dry, after which it was of immaculate whiteness, and sparkled like the frosted snow.—S. L.

Woodpeckers Tapping Sugar Trees.—Upon the Iowa University campus we have a number of grand old aboriginal oaks, a favorite resort for redheaded woodpeckers (*Melanerpes erythrocephalus*). Among the young and growing trees that have been transplanted upon the campus are some sugar maples (*Acer saccharinum*) the bodies of which are six or eight inches in diameter. Seeing the woodpeckers busily tapping upon them I examined the trunks and found them perfectly sound, but the birds had pierced many holes, of the usual size, through the bark and into the cambium layer, where they stopped. The sap was flowing freely from the holes, and, watching the movements of the birds afterward upon the trees, I became convinced that they were sucking the sap and that they had pecked the holes for the purpose of obtaining it. This habit is probably not new to ornithologists, but I am not aware that it has before been noticed.—C. A. White.

THE WHITE-RUMPED SHRIKE.—In a residence of two years in central and southern Iowa, I killed a large number of shrikes, and although the greater number were plainly referable to *Collurio excubitoroides*, there were some that I could not satisfactorily place as belonging either to *C. excubitoroides* or *C. Ludovicianus*,—they seemed to be intermediate between the two; generally nearer the former than the latter. Occasionally an individual would agree very nearly with Baird's description of *C. Ludovicianus*, though without undoubted specimens of the latter bird from the southern states, I was unable to decide whether they were absolutely identical, or in what the difference consisted. I mention this fact to show that, while occasional observations, or observations for a limited space of time, would probably result in the conclusion that *C. excubitoroides* was the only form, close and extended observation would show a strong variation in many cases toward the *C. Ludovicianus* type, while rarely a specimen would be found that would appear to be absolutely of that species. Nevertheless, the typical *excubitoroides* is the predominating, and by far the commonest, form; nor could I observe anything in the habits of the birds pointing to two species or even well-defined varieties; birds mated together sometimes showing considerable differences of plumage.—T. MARTIN TRIPPE, *Orange, N. J.*

TADPOLES IN WINTER.—An esteemed contributor sends us an account of tadpoles that were found early this spring, having passed the winter in that condition, which he considered as perhaps a case of arrested development. It is however well known that the large bull frog (*Rana pipiens*) is (at least in the New England States) two or three years in the larval or tadpole condition, and if retained in a tank and forced to keep up its fish-like life there is no knowing how long the larval state would be retained. The experiments made by Prof. Wyman several years since resulted in keeping the tadpoles for a number of years, and at the end the water was accidentally let out of the tank. If any one will take the trouble of trying the experiment it will probably be found that unless the tadpoles are allowed a chance to hop along shore about the time their legs are developed, they can be greatly retarded in obtaining their perfect form as frogs or toads. Many of our New England species of frogs and toads develop very rapidly, passing through the tadpole condition in a

week or two, while others are naturally much longer in making the change, and probably both *Rana fontinalis* and *Rana pipiens*, and perhaps other species, require to pass one or two winters in the tadpole state.— F. W. P.

THE GOLDEN-WINGED WOODPECKER.—In his "Notes of an Ornithological Reconnoissance of portions of Kansas, Colorado, Wyoming, and Utah," J. A. Allen speaks of specimens of *Colaptes auratus*, taken in eastern Kansas, showing a tendency to the coloration of *C. Mexicanus* in having the "black maxillary patch, more or less tinged with red;" and mentions one from Florida with the same peculiarity. I have observed red feathers in the cheek patches of birds shot at Orange, N. J., in three or four instances; and in one case the black was quite thickly sprinkled with small specks of bright, shining red, more brilliant than that of the nape. Here we have an instance of occasional individuals of one species exhibiting a tendency to vary in the direction of a congeneric species, not occurring within fifteen hundred miles of the former.—T. MARTIN TRIPPE, *Orange, N. J.*

ORNITHOLOGICAL QUERIES.—I wish to make two or three ornithological queries through the pages of the NATURALIST. What are the southernmost localities in which the following species are known to breed? viz: *Regulus satrapa*, *R. calendula*, *Anorthura hyemalis*, *Junco hyemalis*, *Plectrophanes pictus*, *P. Lapponicus* and *P. nivalis?* What is the eastern limit of *Vireo Belli?* and what is the southern and southwestern range of *Pediœcetes phasianellus?* I am very desirous of obtaining information on these points.—T. MARTIN TRIPPE, *Orange, N. J.*

MODE OF EGG-LAYING OF AGRION.— Mr. G. W. Dunn writes us that while collecting at Santa Cruz, California, he observed a species of Agrion (as we find the insect to be) "flying about the water united male and female. The female would light on a spear of grass growing in the water; the male would then let go, and the female go down the grass twelve or fifteen inches under water and deposit her eggs."

HABITS OF MONOHAMMUS DENTATOR.—On the 9th of June, 1872, my attention was directed to a yellow pine (*Pinus mitis*) about fifty feet high and twelve inches in diameter, in which several

holes about the size of a pencil were to be seen at various points on the trunk.

On removing the bark I found an adult insect already free and the heads of several others appearing through the wood. On further investigation during the next few weeks I obtained from the tree no less than eighty of these beetles in all stages of development, which, considering the size of the tree, was a large number. I observed that the largest beetles were near the foot of the tree, and that the larvæ almost invariably avoided a knot on account of the hardness (?) of the wood. Where the diameter of the tree was about six inches the larvæ would bore through the trunk instead of making only a surface bore as they did where the diameter was greater.

The larva is a footless, yellowish white grub, more or less hairy, cylindrical in shape, and about one and four-tenths inches long, and three-twentieths of an inch in diameter. The body including the head is made up of fourteen segments, the last eight of which have a kind of ridge on each side, covered with hairs longer than those which are found on the rest of the body and which doubtless assist it in locomotion, the second segment next the head is flattened on the upper side. On both the upper and under sides of the body are seven raised rough spots at right angles with the ridges on the sides. It feeds on the sap wood or inner bark until autumn, when it turns aside and bores outward leaving its passage filled with chips. Within the distance of from one-half to one-tenth of an inch from the bark it forms a smooth, hollow, curved excavation about the size of an almond in which it undergoes its transformations during the winter or even as late as the last of June.

The pupa is white and varies in size from three-fourths of an inch, to an inch and one-tenth. In this state it resembles the imago, the only difference being that the elytra are not developed.

After remaining in the pupa state during a space of time which varies according to circumstances it is transformed to a beetle and after a short time gnaws its way out, appearing from the first of June to the middle of July. The imago is brownish, mottled with gray, black, and cream color, and varies in size from three-fourths, to something over an inch in length. The two sexes differ in the great length of the antennæ, which in the male are full twice the length of the body, and in the development of the

anterior tarsi, which in the male are much broader than in the female. It is unnecessary further to describe the imago as in this state the dentator is well known. I have only taken these beetles in Massachusetts but have found traces of them in Connecticut and in northern New York, whence it can be inferred that they inhabit all New England. — F. C. BOWDITCH.

THE PAINTED BUNTING.—The *Plectrophanes pictus* visited southern Iowa last fall in great numbers, appearing toward the close of October, but whether it is as abundant every season I cannot say, but am inclined to think that it was far more common than usual, as was the case with almost all northern birds. In its habits it was very similar to the Lapland longspur, but differed in being less gregarious, frequently feeding singly or in small parties of five or six, which the latter bird seldom does, and in showing a partiality for wet meadows and moist low-lying prairie swales, while the longspur prefers the cornfields and higher ground, as a rule, and does not appear until some weeks after *pictus*. The notes and flight of the two species are quite similar, though distinguishable.—T. M. TRIPPE, *Garden Grove, Iowa.*

NEW NORTH AMERICAN HYMENOPTERA. — The last number of the Transactions of the Academy of Science of St. Louis contains a posthumous paper by the late B. D. Walsh, in which many new species of Tenthredinidæ, and Ichneumonidæ are described.

ANTHROPOLOGY.

NOTE ON A COLLECTION OF SKIN SCRAPERS FROM NEW JERSEY.— Since the publication of our notice of the stone implements found in New Jersey, in the NATURALIST for March and April, 1872, our attention has been frequently called to the greater variety of shapes than we then supposed to occur, and to the unusual degree of excellency exhibited in the manufacture of these well known relics. In the paper referred to, we figured four relics as scrapers, each bearing considerable resemblance to the others. In a collection of fifty-four specimens lying before us, we find five types; one of them is the English form, being thin flakes of jasper, of a uniform surface on one side, sloping to either side from a median ridge, and chipped to a bevelled edge in front. The three specimens bear considerable resemblance to those fig-

ured by Mr. Evans on page 273 of his "Ancient Stone Implements of Great Britain." Eleven of these scrapers, all of jasper, are triangular in outline, and of very beautiful finish; exceeding in beauty of form and careful workmanship any figures given by Mr. Evans. Of them, but two are bluntly ended, and but one without the characteristic bevelled edge of scrapers. The triangular form appears, as a rule, to have the scraping edge convex, the sides chipped to a cutting edge, and the implement itself, even when very small, appears to be chipped from a nodule of mineral, and not fashioned from a flake, as those just described. The variation in size of these triangular scrapers, as exhibited in this series, is from two and one-half inches in length by one and five-eighths inches in width, to seven-eighths in length by five-eighths in width. This smallest specimen is in all respects a very beautifully wrought specimen, having the bevelled, or "scraper" edge very distinctly chipped.

The form of scraper that is most usually met with, in our New Jersey "finds," is that which we have described in Vol. vi of the NATURALIST, pages 221–223, the figures of which we here reproduce (Figs. 131, 132, 133, 134). This type, which is a modification of the spoon-shaped scrapers described by Mr. Evans, appears to have been the favorite one among the Delaware tribes. There are twenty-one specimens in this little collection, all of which are carefully wrought, and but three of them are of slate. While in general appearance this form suggests the utilization of the bases of spearheads in their manufacture, we doubt very much, after examining a very large number, if this was the rule. We think, rather, that it was the exception, because this type of scraper very generally is thicker than spearpoints; the stem or handle is thinner than the blade; the upper side or that from which the bevelling proceeds is ridged, while beneath it is flat or nearly so; all of which shows a variation from ordinary spear and arrowheads, which could not have been produced by any chipping of the base of either of those implements. The implements figured in Vol. vi of the NATURALIST, pages 212 and 213, here reproduced as Figs. 135, 136, 137, we now believe to be scrapers and not spear or arrowpoints. The variation in size of this stemmed or modified spoon-shaped scraper is from three inches in length by two in greatest breadth, to one inch in length, by about seven-eighths in width. As in the preceding instance, this smallest

specimen is equally as well wrought as the larger, and varies from them only in having a notched base, rather than a narrow and straight stem. It is flat upon one side and convex upon the other, with a beautifully chipped bevelled edge. It certainly was made

Fig. 131.

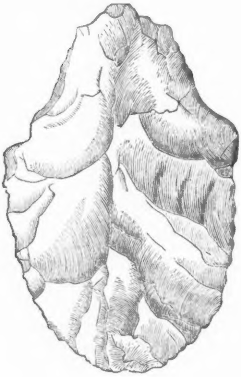


Fig. 134.

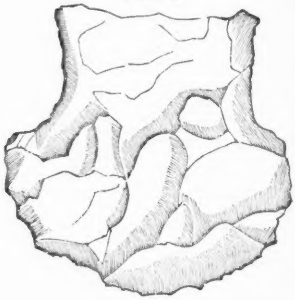


Fig. 132.

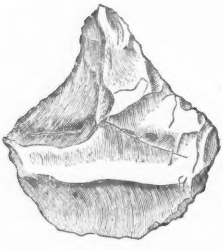
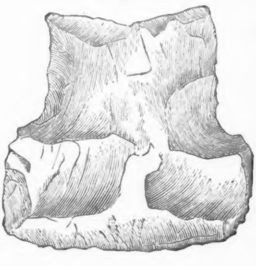


Fig. 133.



from a nodule of jasper directly, and not from a broken arrowhead, chipped into a scraper.

Another small specimen varies from the above in being of much greater width and of the same length. The edge in this case is bevelled from each side, so that the specimen may have been originally an arrowhead. The form of the implement suggests the blunt arrowheads described by Schoolcraft, as being employed by young boys when learning to use the bow and arrow; being made blunt that they might not pierce the target. This type of handled

scrapers varies somewhat in the relative widths of head and handle, so that the gradation to other forms, especially the triangular or kite-shaped, can be traced in every considerable collection.

The form of scraper described by Mr. Evans as "horseshoe-shaped" is represented in the series by seven specimens, while five others approach this type, and are, as it were, connecting

Fig. 135.

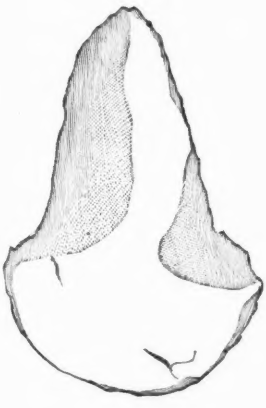


Fig. 136.

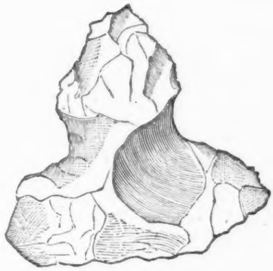
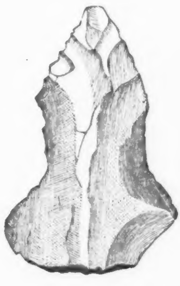


Fig. 137.



links with the preceding types. These twelve specimens are all of jasper, very well chipped over their whole surface, although not as smoothly wrought as the preceding and have well defined scraping edges along certain portions of their margins. In size they are about the same as the specimens figured by Mr. Evans, with probably a smaller proportion of the larger ones.

The spoon-shaped scraper, of which Mr. Evans figures a pretty specimen on page 277 of his work, is represented by three speci-

mens in our series, one of which is very similar to that referred to from the Yorkshire wolds. The others have the bowl of the spoon not so well defined, but otherwise are well made scrapers. There are also three other specimens, that might be more properly called knife-shaped scrapers, in that the bowl and stem or handle are of the same width. The scraping edge is, however, circular, as in the true spoon-shaped form. These may be looked upon as connecting links with the quadrangular or horseshoe-shaped scrapers. There remains one other specimen to notice, being a "side scraper," as Mr. Evans calls this form, that is, one that is broader than it is long. It is made of slate, chipped with some care; is two inches in length by three in width. Both sides are adapted to scraping, being each well chipped, with the lower side flatter than the upper surface. What perhaps might be called the true edge, is somewhat more extended than the other, from the barblike projections at either end, which barbs give a finished appearance to the implement, which otherwise might have been looked upon as merely a flake or unfinished specimen. This form of scraper is not common with us.

After a careful study of these and many other specimens of this form of implement, found in New Jersey, we have determined, we think:

First. That jasper, quartz and allied minerals were preferred in manufacturing scrapers.

Secondly. That as much care was taken in their shaping and finishing, as was the case with arrowpoints and spearpoints.

Thirdly. That but few "flakes" were utilized in making scrapers, as is the case with European specimens.

Fourthly. That the majority of scrapers were intended to be inserted in handles of bone or wood.

Fifthly. That large spearheads especially, and some arrowheads were used for making scrapers, having previously lost their points, and being too short to be repointed.

Lastly. That, as a class, the New Jersey scrapers are smaller than those found in Europe.— CHARLES C. ABBOTT, M.D.

MICROSCOPY.

IMPROVEMENTS IN OBJECTIVES.—Mr. Wenham has placed microscopists, and indeed all persons interested in scientific progress,

under a new obligation, by his last paper on object-glasses, contributed to the Royal Microscopical Society. He seems to be strangely unconscious of the fact that he cares more for human progress than for trade secrets; and he publishes, with the utmost apparent indifference, exactly what the world wants to know, but what it knows too well would be by most persons devoted to secrecy and to personal business purposes.

Introductory to an explanation of his new formula for objectives, Mr. Wenham reviews the history of the modern (English) objectives.

In the year 1829, before which time three superposed achromatic lenses were employed simply as a means of increasing power, the late Mr. Lister discovered and published the law of aplanatic foci, that by separating suitably connected lenses one or two positions could be found in which spherical aberration was balanced; and Mr. Ross constructed in 1831, with unexpected success, the first objective embodying this principle. Mr. Ross then discovered that the interposition of a cover-glass removed the aplanatic focus to a different plane, causing negative aberration and requiring the lenses to be brought closer together; and he therefore introduced the screw collar adjustment which has now become universal. These objectives consisted of three pairs, the double convex crown and plano-concave flint of each pair having their contact surfaces of equal radius and balsamed together, the three pairs having foci about in the proportion of one, two, three, and the anterior pair being at a considerable and variable distance from the other two pairs. In this combination the softness of the flint glass forming the first plane surface was unfortunate, and the angular aperture of a $\frac{1}{8}$ was limited to 60°.

In the year 1837, Mr. Lister furnished Mr. Ross a diagram of a triple front lens, consisting of a plano-concave of flint between two plano-convex crowns, for the purpose of protecting the flint from the exposure to the air and of diminishing the depth of curvature, which was unfavorable for the passage of the marginal rays. The front surface of the middle pair was made concave with no other advantage than reducing the depth of contact, and it may be made a plane with at least equally good results in correction of the oblique pencils and in flatness of field. An angle of 80° was attained, by this method, in one-eighths.

Thirteen years later Mr. Lister introduced the triple-back, for the same objects as the triple front, it being composed of a double concave of very dense flint between a plano-convex and a double convex of crown. Thus more marginal rays were collected, and the aperture of a $\frac{1}{8}$ raised to 130° or over.

At that time Mr. Wenham, experimenting in the construction of objectives, discovered that excessive over correction or negative aberration was easily obtained with lenses of shallow contact curves, and that color correction was chiefly controlled by changes in the triple back, the rays passing through the concave flint of the triple front so nearly in the direction of its radii that great changes in its curvature possessed only feeble chromatic effects. This led him to introduce the now familiar single front of plano-convex crown glass which was long rejected by the leading opticians, but is now used by all of them. The first $\frac{1}{8}$ constructed on this system possessed an angular aperture of 130°, and was successful at first attempt, the middle pair being neutral or nearly achromatic and the triple back happening to have a suitable excess of negative aberration or over correction for color. Some positive spherical aberration remained, which was remedied by giving additional thickness to the front lens; a correction now considered essential and requiring great delicacy, as a difference in thickness of $\frac{1}{500}$ inch will determine the quality between a good and an indifferent $\frac{1}{15}$.

The excessive depth of the contact surfaces of the middle pair was a remaining defect, it being so great that if not balsam cemented, total reflection of the marginal rays would take place, and the angular aperture be reduced. Though the surfaces are obliterated by being cemented with balsam and the rays are thus enabled to proceed, still an angle beyond that of total reflection, implies excessive and detrimental depth of curvature. Placing the flint in the form of a meniscus above a plano-convex crown was employed as a middle pair with some satisfaction. An attempt was also made to obtain the whole chromatic correction with the biconcave flint of the back, the middle as well as the front being a single uncorrected plano-convex of crown. Sufficient over correction was obtained by the back to balance both the other lenses, but the red and blue rays, for instance, had become so widely separated in the front and middle lenses and between them when placed for aplanatic foci, that they could not be brought

together again at the point of leaving the back lens, and must either leave it converging to some one fixed conjugate focus, or else parallel but not united; in the first case the combination could only be applicable to one fixed length of body, and in the other it would not be satisfactory under any conditions. The cure for this seemed to be, and proved to be, to transpose the single middle and the triple back; the over corrected triple bringing together the rays which had been separated by the single front, and the single lens of longer focus making the rays parallel at the point of final emergence. The single front is nearly alike in all cases, varying only with the power required; the triple middle is of about three times, and the single plano-convex back four and a half times the radius of the front. The single plano-convex of long focus is reversed when transferred from the middle to the back position, the plane surface being above instead of below. Perfect color correction can be obtained by this formula in all screw collar objectives, from $\frac{1}{2}$ inch upwards. This combination consists of five lenses and ten surfaces, taking the place of eight lenses with sixteen surfaces.

These results are worked out by diagrams more easily than by mathematical computation; the course of the rays being projected by means of proportional compasses, with surprising accuracy, on a scale of some fifty times the size of the real combination.

Tolles' Triplets. — A correspondent writes as follows regarding a half inch triplet lately made by Mr. Tolles. "I am greatly pleased with the lens. Its performance is *splendid*, and it really gives the naturalist when away from his microscope an extraordinary facility. I should be very sorry to be without it." We quote this from our friend's letter, which was by no means designed for publication. These triplets certainly surpass anything of the kind we have met with. Mr. Tolles has just finished a $\frac{1}{75}$ objective, which is perfectly satisfactory to himself.

NOTES.

It is seldom that the sad record we are now obliged to make occurs in a single number of a magazine: — the loss by death of four valued contributors within so short a time.

Prof. John Lewis Russell, of Salem, died on the 7th of June, in the 65th year of his age. Prof. Russell was one of the founders,

and for many years the president, of the Essex County Natural History Society, which afterwards became part of the Essex Institute. He was an active worker in botany, and though he never published the results of his labors to any great extent, he has for years been considered as an authority in New England cryptogamic botany to which he devoted most of his attention. Of a peculiar and retiring nature, he never made himself prominent among the scientists of the day, though by those who knew him intimately his learning was held in great respect. As a popular exponent of botanical subjects he was much appreciated.

Mr. George Gibbs, the distinguished American ethnologist and philologist, died at New Haven, on the 9th of April, in his fifty-eighth year. Mr. Gibbs, though a lawyer by profession, has been an extensive contributor to various departments of natural science, as well as to literature, but his special work since 1849, when he first visited the Pacific coast, has been in researches relative to the languages and history of the North American Indians. Since this period he has filled several important posts as geologist on several of the government surveys and added much to our knowledge of the geology and zoology of the western portion of our continent. At the time of his death he was engaged in superintending the printing of a quarto volume of the Smithsonian Contributions, containing several hundred series of Indian vocabularies which he had arranged in a most critical manner. We understand that this last work of Mr. Gibbs was so far perfected, that its completion will be entrusted to Dr. Roehrig who was assisting in the work.

Col. John W. Foster, President of the Chicago Academy of Science, died at Chicago on the 29th of June, aged 58. Col. Foster, though an active laborer in science for many years, is perhaps best known as the joint author with Prof. Whitney of the government Report on the Mineral Lands of Lake Superior, published in 1850, and from his volume on the Mississippi Valley published a few years since, though he has contributed many papers and memoirs on geological and archæological subjects. He contemplated a series of articles on the "Mound builders of the Mississippi Valley" for this magazine, two of which were published, when his time became fully occupied in the preparation of a more extensive work on the subject, which was issued but a few weeks before he died. He was one of the original members

of the American Association for the Advancement of Science, of which he was president at the meeting held in Salem in 1869, and for many years has taken an active part in the proceedings of the Association.

Prof. HENRY JAMES CLARK died at Amherst, on July 1st, at the age of forty-seven. Prof. Clark first became known to the scientific world as a very promising student with Prof. Gray. He afterwards, and for twelve years, was associated with Prof. Agassiz as an assistant. In 1860 he was made adjunct professor of Zoology at Harvard, and afterwards held professorships at the Agricultural College of Pennsylvania, the University of Kentucky, and finally in 1872, at the Massachusetts Agricultural College at Amherst, where after much suffering his useful work was terminated. Prof. Clark was probably the most thorough histologist in this country, and was our best microscopist in the general acceptance of the term. His volume entitled "Mind in Nature" published some ten or twelve years since was the result of his micro-physiological studies. He was a large contributor to Prof. Agassiz' volumes on the Natural History of the United States, and he has also printed many important papers in the Memoirs of the American Academy, the Boston Society of Natural History, and various scientific journals. We understand that the Smithsonian Institution was publishing an extensive work by Prof. Clark, which we trust will not be delayed by his death. Prof. Clark was a member of the National Academy of Science and of the leading scientific societies in the country.

IT appears that the scientific results of the voyage of the Polaris, as revealed by the examination by the Secretary of War of Capt. Tyson and his comrades, when the vessel is rescued, as there are strong hopes she will be, promise to be very encouraging to the advocates of farther arctic explorations. The Polaris reached 82° 62′ north, where she was in the new straits she had discovered. The dredge was not used, but the records of the astronomical, meteorological, magnetic, tidal, and other departments of exploration appear to have been full, while the collections of natural history, including skins and skeletons of musk oxen, bears and other mammals, birds and eggs, marine invertebrates, plants and fossils, were very numerous.

Specimens of drift wood of the walnut, ash and pine were said

to have been picked up near the shores of Newman's Bay and Polaris Bay. On the shores of the latter bay in lat. 81° 38′ N. Capt. Hall "found that the country abounds with live seals, game, geese, ducks, musk cattle, rabbits, wolves, foxes, bears, partridges, lemmings, etc., etc."

The geographical results of the Polaris expedition, so far as they can now be ascertained from the testimony of Messrs. Tyson, Myers and their comrades, may be summed up briefly as follows. The open Polar sea laid down by Kane and Hayes is found to be in reality a sound forming an expansion of Kennedy channel to the northward and broken by Lady Franklin Bay on the west, and on the east by a large inlet twenty miles wide at the opening and certainly extending far inland. Its size was not ascertained, and Mr. Myer thinks it may be in fact a strait extending till it communicates with the Francis Joseph sound of the Germania and Hansa expedition, and with it defining the northern limits of Greenland. This inlet was called the southern fiord. North of it is the indentation of the shore called Polaris Bay by Captain Hall, where the Polaris wintered in lat. 81° 38′ north. The northern point of this bay was named Cape Tupton. Its southern point is yet without a name. From Cape Tupton the land trends to the northeast and from the eastern shore of a new channel from twenty-five to thirty miles wide opening out of the sound before mentioned. The trend of land continues to Repulse Harbor in lat. 82° 9′ north, the highest northern position reached by land during this expedition. From an elevation of 1700 feet at Repulse Harbor, on the east coast of Robeson's Straits, the land continues northeast to the end of these straits, and thence east and southeast till lost in the distance, its vanishing point bearing south of east from the place of observation. No land was visible to the northeast, but land was seen on the west coast, extending north as far as the eye could reach, and apparently terminating in a headland 84° north. Mr. Myer also stated that directly to the north he observed, on a bright day, from the elevation mentioned, a line of light, apparently circular in form, which was thought by other observers to be land, but which he supposed to indicate open water. Besides ascertaining accurately the condition and extent of what was before supposed to be an open polar sea, discovering the southern fiord to the southeast, and Roberts's Straits to the north, with another wide expanse of water beyond it and ex-

tending by examination and survey the coast line on the east up to latitude 82° 91′ north, and by observation somewhat farther prolonging the west coast to the northward and passing with the Polaris under steam the high latitude of 82° 16′ north — a point far beyond the limits of all previous navigation toward the pole—errors in the shore line of the west coast as laid down by Dr. Hayes, and also errors in the shore line of Greenland as laid down by Dr. Kane, were observed and corrected.

Mr. Clement R. Markham writes to "Nature" that from the results gleaned from the story of the boat's crew of the Polaris, there are renewed and strong arguments for the fitting out of an English arctic expedition, which has been urged for a year or two past.

The government has dispatched two vessels in search of the Polaris, with a good prospect of finding her and saving the valuable journals and specimens aboard.

Prof. C. A. White of Iowa State University and State Geologist of Iowa, has been appointed Professor of Geology and Natural History at Bowdoin College. This is a new chair, and its establishment shows that the interest in science that has always characterized this college is on the increase. The Cleaveland Cabinet of Natural History at Bowdoin College was dedicated July 10. The museum, formerly Massachusetts Hall, has a very handsome interior. The address was delivered by Hon. Nehemiah Cleaveland, and remarks were made by other gentlemen present.

The bryological books and exceedingly rich and important collections and preparations of mosses left by the late W. S. Sullivant are to be consigned to the Gray Herbarium of Harvard University, with a view to their preservation and long-continued usefulness. The remainder of his botanical library, his choice microscopes, and other collections are bequeathed to the State Scientific and Agricultural College, just established at Columbus, and to the Starling Medical College, founded by his uncle, and of which he was himself the senior trustee.

The Topeka Scientific Institute is the title of a society in Topeka, Kansas, two years old, devoted to general science. It closed for the season on April 18, having sustained a free course of popular scientific lectures during the winter.

BOOKS RECEIVED.

Catalogue of the Pyralidæ of California with descriptions of new Californian Pterophidæ. By A. S. Packard, Jr. 8vo. pp. 15. (From Ann. Lyc. Nat. Hist., N. Y., Vol. x, No. 9, 1873.)

Fifth Annual Report of the Trustees of the Peabody Institute, Danvers, Mass., for the year 1871. 8vo. pp 19. Salem, 1872.

Speech of Hon. Geo. B. Loring, President of Massachusetts Senate, on the Museum of Comparative Zoology, in Senate, March 26, 1873. 8vo. pp. 32. Boston. 1873.

Key to North American Birds, containing a concise account of every living and fossil bird at present known from the continent north of the Mexican and United States boundary. Illustrated by six steel plates and upwards of two hundred and fifty woodcuts. By Elliot Coues, Assistant Surgeon U. S. A. Royal 8vo, pp. 361. Salem, 1872.

On the Agency of Insects in Obstructing Evolution, etc. 8vo. By Thomas Meehan. (From Proc. Acad. Nat. Sci., Philadelphia. Sept.-Nov., 1873.)

Bulletin Mensuel de la Societe d'Acclimatation. 8vo. Tome ix. No. 12. Dec., 1872. Paris.

Catalogue of a Series of Photographs from the Collections of the British Museum. 8vo. pp. 122. London.

Bulletin de l'Athenee Oriental. Paris. Serie 2. Tome ii.

Verhandlunger der k. k. geologischen Reichsanstalt. Wien. Nos. 14–18. 1872.

Jahrbuch der k. k. geologischen Reichsanstalt. Wien. Band xxii. No. 4. Oct.-Dec., 1872.

Bulletins de la Societe Imperiale des Naturalistes de Moscou. Moscou. Tome xlvi. No. 3. 1872.

Beilage. No. 2, zu den Abhandlungen des Naturwissenschaftlichen Vereins zu Bremen. Tabellen uber den Flacheninhalt des Bremischen Staats den Wasserstand der Weser und die Witterungsverhaltnisse des Jahres, 1871. 4to, pp. 9. Bremen, 1872.

Sitzungsberichte der physicalisch-medicinischen Societat zu Erlangen. 8vo. Heft. 4. Nov., 1871. Aug. 1872. Erlangen, 1872.

Siebenundfunfzigster Jahresbericht der Naturforschenden Gesellschaft in Emden. 8vo, pp. 44. Emden, 1872.

Kleine Schriften der Naturforschenden Gesellschaft zu Emden. Die Winde in ihrer Beziehung zur Salubritat und Morbilitat. Von Prof. Dr. Prestel. 8vo, pp. 19. Emden, 1872.

Melanges Orthopterologiques. Par Henri de Saussure. ivme fascicule Mantides et Blattides. Tome II. 4to, pp. 164. 3 Plates. Geneve, 1872.

Sitzungsberichte der Kaiserlichen Akademie der Wissenchaften. Mathematisch-naturwissenschaftliche Classe. 8vo. Band lxv. Hefte 1-5, Erste Abtheilung. Hefte 1-5, Zweite Abtheilung. Hefte 1-5, Dritte Abtheilung. 5 pamphs. Wien, 1872.

Register zu den Banden 61 *bis* 64 *der Sitzungberichte der mathematisch-naturwissenschaftlichen Classe der kaiserlichen Akademie der Wissenschaften.* 8vo, pp. 98. Wien, 1872.

Denkschriften der Kaiserlichen Akademie der Wissenschaften. Mathematisch-naturwissenschaften. Mathematisch-naturwissenschaftliche Classe. 4to. Band xxxii. 32 Plates. Wien, 1872.

Preisaufgabe fur den von A. Freiherrn v. Baumgartner gestifteten Preis. 8vo, pp. 3. June 13, 1872.

Preisaufgabe. 8vo, pp. 2. June 12, 1872.

Nickel and its Uses in the Arts, Coinage and Nickel Plating. By Lewis Feuchtwanger. 8vo, pp. 19. New York.

Proceedings of the Royal Society of Edinburgh. 8vo. Nov., 1869—June, 1872.

The Geological Survey of Ohio. Reports on the Counties of Sandusky, Seneca, Wyandot and Marion, and The Surface Geology of Northwestern Ohio. By N. H. Winchell. 8vo, pp. 89.

List of Scientific Journals, with abbreviated titles, compiled for the use of the Recorders. 8vo, pp. 16. London, 1873.

Zeitschrift fur die Gesammten Naturwissenschaften, Band v, pp. 530, 5 plates. Band vi, pp. 550, 3 plates and 12 woodcuts. Berlin, 1872.

Zoologische Miscellen. By George Ritter von Frauenfeld (aus den Verhandlungen d. k. k. zoologisch-botanischen Gesellschaft in. Wien. [Jahrgang, 1873] besonders abgedruckt.) 8vo, pp. 16.

Sitzungsberichte der Gesellschaft Naturforschende Freunden zu Berlin im Jahre, 1872. 8vo, pp. 106. Berlin, 1872.

Verhandlungen der Kaiserlich-Koniglichen zoologisch-botanischen Gesellschaft in Wien. Band xxii. 8vo, pp. 742. 7 plates, Wien, 1872.

Proceedings of the Academy of Natural Sciences of Philadelphia. 8vo, pp. 249-264. 1873.

The Ancestry of Insects. Chap. xiii *of Our Common Insects.* By A. S. Packard, Jr. 12mo, pp. 39. (Published, June, 1873.) Salem.

Proceedings of the American Association for the Advancement of Science. Vol. xxi, 1872. 8vo, pp. 295. Cambridge, 1873.

The Spectroscope and its Applications (Nature Series). By J. Norman Lockyer. 12mo, pp. 117. With colored plate and illustrations. London and New York, 1873.

Abhandlungen herausgegeben vom naturwissenschaftlichen Vereine zu Bremen. Bd. iii. Heft. 3. Mit 3 Tafeln. Bremen. 1873.

Beitrage zur physikalischen Geographie der Presburger Gespanschaft. By Dr. G. A. Kornhuber. 8vo. Presburg. 1865.

Annales de la Societe Entomologique de Belgique. Tome 15. Bruxelles. 1871-1872.

Synopsis of the Thysanura of Essex County, Mass., with Descriptions of a few Extralimital Forms. By A. S. Packard, Jr. 8vo. pp. 29. (From Fifth Annual Report of the Peabody Academy of Science.) July, 1873.

Land and Water. London, June 7, 14, 21, 28, 1873.

Field. London, June 14, 21, 28, 1873.

Academy. London, June 14, 1873.

Revue Scientifique. Paris, June 14, 21, 28, 1873.

Nature. London, June 12, 19, 26, 1873.

Proceedings of the California Academy of Sciences. San Francisco. Vol. v. Part 1, 1873.

Journal of the Franklin Institute. Philadelphia, July, 1873.

Science Gossip. London, April, May, June, '73.

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